73 magazine

for radio amateurs

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JULY 1974

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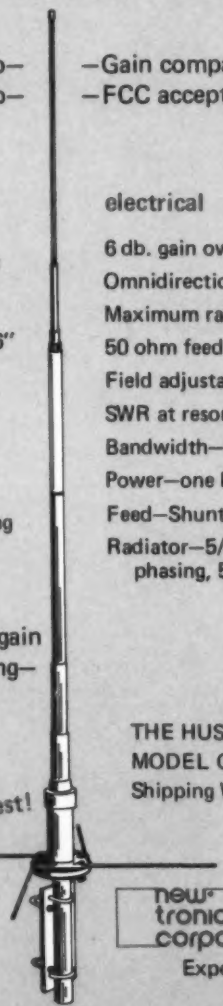

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73 magazine
for radio amateurs

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EDITORIAL STAFF
Wayne Green W2NSD/1
Yvette Grimes WA8ULU/1

ASSOCIATES
Gus M. Browning W4BPD
Tom DiBiase WB8KZD
Terry Fox WB4JFI
Mike Frye WB8LBP
Dave Ingram K4TWJ
Joe Kasser G3ZCZ/W3
Bill Pasternak WA2HVK/6
Jonathan Tara WB8DBN
Bill Turner WA0ABI

PRODUCTION
Lenore DeLiguori
Lyman DeLiguori
Karen Hebert
Biff Mahoney
Lynn Panciera-Fraser
Bob Sawyer
Barbara Walker

BUSINESS
Knud E. Keller KV4GG/1

CIRCULATION
Barbara Block
Dorothy Gibson

TRANSPORTATION
Bill Berry
Marshall Raymond

DRAFTING
T. M. Graham W8FKW
Bill Morello
Wayne Peeler K4MVW

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73 Magazine is published monthly by 73, Inc., Peterborough, New Hampshire 03458. Subscription rates are $7 for one year in North America and U.S. Zip Code areas overseas, $8 per year elsewhere. Two years $12 and $13 overseas. Three years, $15, and $16 overseas. Second class postage paid at Peterborough, New Hampshire 03458. Phone: During office hours 603-924-3873, other times there is a tape recorder for messages on 603-924-3883. Microfilm edition of 73 available from University Microfilms, Ann Arbor MI 48106. Magnetic tapes available from Science for the Blind, 332 Rock Hill Rd., Bala Cynwyd PA 19904. *Entire contents copyright 1974 by 73 Inc., Peterborough, NH 03458.*

EDITORIAL BY WAYNE GREEN

THE IRS GOAL

The IRS works diligently to make sure that there will be stories in the newspapers, on the radio and on television telling of people who have been convicted of tax fraud — and they try very hard to see that these cases come off just before tax filing time. This is part of the IRS campaign of fear which helps keep taxpayers in line. They orchestrated my trial so the verdict would come out in time for national publicity just before tax return filing time. The IRS, with unlimited funds and the best of legal talent available from the Justice Department in Washington, virtually never loses a case.

IRS WIN?

While I expect that the next issue of Worldradio will headline that Green has been convicted by the IRS of income tax fraud — sentence suspended and probation for three years — the actual story is almost totally hidden by the IRS press release, as you might expect.

The whole purpose of many of the "trials" for tax fraud is to generate articles in the newspapers and magazines at tax time to frighten taxpayers into complete submission. If editors would refuse to give the IRS the PR they want, this whole program would fail and hundreds of people would be spared the trauma every year of being indicted, tried and found guilty of tax evasion — whether they have actually done anything wrong or not — a process that is helping to destroy faith in our government.

Yes, I sat through a trial, listening to a couple of people lie in order to protect themselves, and unable to say anything — to fight back —even to argue. I can see why the Chicago Seven let loose — the temptation was almost overpowering at times. Even so, there was never any testimony or evidence at all that I did anything wrong — nothing was hidden — books weren't altered — I had depended entirely on the accountants to prepare tax returns — I hadn't even read them over as Nixon did (he has a lot of tax expereince — I haven't).

My lawyer felt that since no case had been made against me that we had nothing to worry about so he made virtually no defense or closing statement. Much has been written about having to prove oneself innocent in these courts and I can verify that. Even though the testimony of the accountants was that I depended on them to allocate all business and personal expenses, the jury of my peers (retired postal employees, housewives, etc.) decided that "I should have known that the tax returns weren't right." *GUILTY!*

So we're appealing the case.

There is so much to write about this that there is no way to present the material within the pages of 73. Those who are interested in getting the inside information on how the IRS works — how they defy constitutional protections with impunity — how they can win fraud cases even when the pidgeon is innocent (and they know it), should watch for the first of my books on the IRS.

May I ask that all readers keep your eyes peeled for newspaper clippings of IRS harassments and send them to me. My file is growing and the horror of the story the clippings tell is honestly beyond belief. I shall write this story.

In the meanwhile I am back at my regular stint, working at 73 day and night, and the magazine is doing well. There never was any serious problem as far as the magazine was concerned anyway since our carry-back losses for 1969 and 1970 more than cover any possible tax the IRS could come up with for the previous years. That's about the only benefit there is to losing money — and we did lose a bundle in those two years.

You didn't think the IRS was going to take my pressures on them lying down, did you?

OUT OF ONE POCKET THE IRS GETS THEIR CUT

Have you ever stopped to think of how come government employees have to pay income taxes? Does this make any sense at all?

The government salaries come from taxes collected, like from the income tax. So all that is happening is that Uncle Sam is giving with one hand and taking it back with the other. Unfortunately, the money doesn't just get from one hand to the other without going through a lot of other hands, each a little sticky.

The IRS charges for their collection service. In fact it costs more to keep this den of thieves running than it does the whole postal system, as incredible as that may seem. In point of fact the Treasury (IRS) is the third most costly department of the government, with Defense and Health beating them out on expenses. The Treasury spends over 10% of the total government budget! It costs a lot to take the money from one pocket and put it back in the other when a government bureau is in the middle.

If all government salaries could be made tax free that would result in an immediate reduction of about 20% in the salary overhead of the government, but would reduce the income tax receipts by only about 7%, leaving a substantial net gain.

Considering the cost of the Treasury Department, perhaps more effort should be made to work out an alternative to the income tax. There has to be a more efficient way of paying for government.

DAYTON SMASH HIT! OVER 9000 REGISTERED

Trot out the adjectives — Dayton rated all of them. The exhibitors all went home smiling for most of the 9000 hams who attended the Hamvention brought money and spent it. One distributor claimed to have sold nearly $30,000 worth of merchandise — one chap sold over $3000 in batteries alone — and so it went. Exhibitors remarked that the crowd on Friday alone was better than any other hamfest or convention has been able to turn out for an entire weekend.

Gordon West WB6NOA of Standard Communications took one look at the May Streaker cover and flipped! For that matter, this cover was the center of a lot of attention at Dayton, with fellows turning up every few minutes who had heard about it and wanted to get a copy before they ran out. For those readers who are not sophisticated enough to know a boy from a girl when they see one, the cover was a male type boy, despite the longish hair. Long hair seemed compatible with streaking. The streaking took place right here in Peterborough and the streakee was the brother of one of the lovely gals in the art department.

Gordon was in high humor after hearing how well his SC-R146A HT's were selling through his distributors. They were everywhere and you never heard such a mess as 94 during the Hamvention.

The flea market (above) had over 700 displays and covered over seven acres. Dedicated scroungers were hard put to do the assortment of stuff even on the long weekend.

Bob Brown W2EDN of VHF Engineering had a chance to show and tell his new line of repeaters and his under $100 HT's. The audience at the FM session ate it up.

Wayne W2NSD/8 and Yvette WA8ULU at the 73 booth at Dayton. Subscriptions, code tapes and books all sold extremely well, keeping them busy for the whole weekend.

The three day convention was decidely a success. The complaints were few (there are always *some* complaints) and had to do with a need for better scheduling of tech sessions and an earlier closing on Sunday.

The FM sessions were most helpful in getting everyone up to date on the latest FCC twists and turns – bringing out needs for repeater council cooperation – and a solidifying of agreements on FM and repeater standards.

RESTRUCTURING AMATEUR RADIO

The FCC has a list of 43 petitions for rule making that have piled up – many of them contradictory. They probably have been putting off action on these (some for many years) because the changes which they would make are major ones and call for some basic rethinking of the whole structure of our licenses.

We have six different types of amateur licenses right now. Do we really need that many or can we simplify the structure a bit? Five of these classes have different frequency allocations. Do we really need that many? Should we continue the Technician license as it is – a sort of dead end for two meter FM? Should we open part of 10m for Techs as petitioned by the ARRL? Should we give Novice priviledges to Techs so they can work some CW bands if they want to improve their code as petitioned by me? Should we have more phone bands? Should we get rid of AM on the low bands once and for all? If we do get rid of AM, should we then permit SSB and CW to use any frequencies they want, and go to an agreed sub-band setup rather than an FCC allocated one? How about a Communicator or Hobby class license, perhaps for 220 MHz, as a starter? Perhaps we need a CW Extra and a Phone Extra license setup so phone ops won't have to pass a 20 wpm code test, which seems difficult to rationalize. Is it time to set up a whole new call sign arrangement so amateurs can just about have the call of their choice?

DON'T PANIC

If the FCC has any favorite restructuring plans for us they are keeping it quiet, and I was assured that they do have an open mind about all this and are more interested in the amateurs coming up with a plan that they want than in dumping one of their own making on us. Perhaps the trauma of the repeater license rules is fresh in their minds and they would like to try their best to avoid replaying that one. And in something as emotional as restructuring, the heat generated by Docket 18803 was just a candle next to a blast furnace.

The fact is that a great many amateurs are reactionary – they don't like change and will fight it, bitterly. Since change is inevitable (at least until immortality is discovered), I have always felt that we should accept the fact that there is going to be constant change and try to turn this to our advantage rather than fighting it.

The recent headlines in CQ about restructuring the licenses was not a reflection of FCC intent, but just a bunch of wishful thinking on the part of the magazine, bent more on promoting their own petition than on reporting news. There is a need for a good deal of thinking and planning before the FCC can come up with a notice of rule making – and the FCC is asking that you start working out your ideas for them. I would suggest that you bounce your ideas off the members of your local club before forwarding them to the FCC as this may help to weed out half baked schemes which will create more heat than light.

In case it does not go without saying, the letters pages of 73 are wide open for ideas on license structures and band plans.

CW?

One key concept you'll have to come to grips with has to do with the Morse Code. The present license structure is built around the code and the skill of being able to copy code is the single most important factor holding back advancement in license classes. In view of the almost total lack of use of CW for other than amateur radio, is this still important enough to hold this position?

We don't want to just throw open the gates, so to speak, for the mass input of CBers into amateur radio, complete with their disregard of the rules, which is frightening to consider. And on the other hand, with the number of amateurs steadily dropping, obviously something radical must be done to get things turned around. My own idea is to try to get the ARRL to spend some money (and they have a million dollars just sitting there unused) to get PR for amateur radio – and maybe even to advertise it. I prefer that to debasing the entrance exam because I feel that the less people have to work to get ham licenses, the less they will appreciate them. The Novice ticket is so simple a ten year old can hack it, so why go simpler than that?

I won't cover all of the arguments – you do that – okay?

OTHER PLANS

For argument more than a real proposal, the FCC has come up with an ultra-simple license plan – sort of an answer to CBers who want to get a ham license and talk with their buddies all over the country while sitting back with a cold beer after a day on the assembly line.

Entry
Form 1
Form 2
Universal Class License

(Continued on page 92)

SSTV SCENE

Dave Ingram K4TWJ
Rte. 11, Box 499, Eastwood Vil. 50N
Birmingham AL 35210

A Slow Scan milestone was recently accomplished when Johnny Bjornulf LA2BK, and Knut Gjertsen LA2PH/mm, successfully transmitted and received solid copy color SSTV pictures between Norway and the ship "Thorsage" which was in the South China Sea area. One of their best quality pictures, that of the newborn Prince Haakon Magnus, has appeared in magazines and newspapers throughout the Scandanavian area. Their QSOs were on 20m, and considering the distance involved, was quite a feat for our present band conditions.

Tic-Tac-Toe

On the lighter side of record setting events is W6EYY and WA7QBV's recent on-the-air tic-tac-toe game. Hal and Bob were located too close for a 15m QSO, and WB9GCS, hearing them both, acted as relay in this "3 corner event." No doubt that called for some lights, camera and tape recorder work! Who knows, today's games may point up tomorrow's possibilities.

Killer Tornadoes

The nationwide outbreak of killer tornadoes during April of this year pointed up the need for Slow Scan TV during emergencies. 2m autopatch operations have proved their merit during such times, now consider what an advantage SSTV coverage would be also. Pictures could be relayed back to TV stations, safety officials and newspapers immediately after a tornado, flood, earthquake or whatever. Concerned parties could see immediately the exact situation, and what steps should be instigated. Relief missions would have an idea of what awaited them. Just as 20m provides worldwide coverage, 2m provides local coverage. Obviously SSTV will soon fill this vital need. A camera and monitor would not necessarily need to be carried into the particular area. For example, Polaroid photos could be taken, then carried back a few miles to an SSTV setup. Or, a flying spot scanner might be carried in and the photos put into this. I have worked a couple of fellows mobile using Robot gear, and I'm sure if 15Hz sync lock is a problem, some of you could come up with a simple crystal time base counter for mobile operations. In fact, a SSTV camera is all that's really necessary in this type situation. Once you get familiar with your particular camera, you can practically focus it by the lens calibration (which is not critical for distant shots, compared to "close-ups"). "F" stop adjustments can be "guesstimated" within close accuracy by listening for the swing of the camera's SSTV output on an earphone. Two SSTV operators working together over, say a 2m link, could focus a camera onto a scene within a minute or two; the "fixed" one observing a monitor and the "mobile" adjusting the lens. Sports photographers use a wire "sight" on their cameras for quick view finding. This idea could help you "view find" your SSTV picture easily. Use your imagination and consider these thoughts. SSTV is as useful (or useless) as we make it.

Have you ever noticed those little one dollar battery operated slide-viewers, you drop a slide in and it energizes a light for viewing? I couldn't help but think how dandy one of these would be for Slow Scan, so I bought one and mounted it beside my desk where the Robot Camera could be turned to look into it. Now, after marking the camera's lens settings for quick adjustment, the camera may view either the operating area or slides. The real advantage of this little "goodie" is that slides can be transmitted even in a very dim shack. (That's quite handy for tilting and IDs also.) After making a few slides using Datamark Letters, I dropped in some Instamatic 124 negatives and switched the camera to video invert. That worked so well I now use the Instamatic and have negatives only processed. (That is inexpensive enough to be worthwhile.) These little viewers are really hard to beat for a dollar "slide chain."

While on the subject, I might mention it's *definitely best* to place the viewer so the camera stays *horizontal*, not pointed down. Pointing a TV camera down can cause any impurities in the vidicon (or camera tube) to fall on the ultrasensitive target, permanently scratching it thus causing black spots or scratches to appear in all later televised pictures. Keep those camera's horizontal if at all possible!

Dayton

This year's Dayton convention was unquestionably the biggest milestone yet for SSTV. Although last minute problems prevented me from attending, Jerry W4CAH, provided a grand account of activities. The Digital Slow to Fast Scan converter made its debut in fine style. There were 2 or 3 of these scan converters displayed and although each use slightly different circuitry (recent SSTV Scene articles have briefly described these various units), they all use basically the same principle; that of converting a Slow Scan picture into a digital equivalent, loading this into memory, then reading it out of memory at a regular Fast Scan rate. Variations were in methods of loading and unloading. I understand the Fast Scan converted pictures were quite outstanding due to their brightness and persistance. The pictures would appear in the familiar "window shade pull down" fashion for SSTV but less the bright initial trace. Further, newly received pictures erased previously displayed pictures completely on the first "sweep," whereas the conventional P7 phosphur monitor usually requires 2 sweeps. For example, if a frame is stopped in the middle, the "top" of the new frame and the "bottom" of the old frame were equally illuminated and equally visible. Also, the last frame received would continue to be displayed on the fast scan monitor until the "erase" mode was energized. Incidentally, the system I have just described (load on the fly technique) was that of Robert WØLMD, who also lectured and distributed descriptive information on his unit. It may be a while before Robert's unit appears in print, as there are other operation expansions planned, and memory IC costs are still prohibitively high (his 65,000 bit memory exhausted *known* surplus sources) for most individuals. However, Robert does have circuit information, descriptions, scope patterns, etc., available for his cost of processing, $2.50. WA9UHV, has PC boards of the converter designed and built, but not completely tested. Availability is presently unknown, as other modifications may be added to the boards.

Another very interesting item, especially for those of you interested in APT weather satellite picture reception, was the converter unit Ralph WB8DQT, presented. This unit would permit either a scope or SSTV monitor to be used for direct readout of pictures. His unit is straightforward and relatively inexpensive and will probably come out in print very soon. If you really want to try something unusual, don't pass up the satellite idea. (Again, recent SSTV Scene articles had some information.)

Finally, for those of you building magnetically deflected monitors or FSS, I understand Brooks Radio and TV Corp., 487 Columbus Avenue, New York NY 10024, has a fairly large stock of 70° deflection yokes available for approximately $2 each, and descriptive information is usually included. Possibly this will turn into another good source of SSTV "goodies."

K4TWJ

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Six channels at $199 = $33.16 per channel
Five channels at $289 = $57.80 per channel . . .

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TURKEY RUN

The 27th Annual Turkey Run Hamfest and VHF Picnic, sponsored by the Wabash Valley ARA, Inc., will be held Sunday, July 28, at Turkey Run State Park near Rockville, Indiana. Don't miss the Midwest's finest fleamarket. Fun for the whole family: XYL Bingo and fleamarket; food and refreshments, camping facilities, and park recreation for the kids. First Prize: Genave GTX-10, Second Prize: Regency HRT-2, Third Prize: Drake WV-4 VHF Wattmeter; plus many more. Activities begin at 9:00 AM with free coffee and doughnuts. Talk-in 146.94 by W9UUU/9. For details, send SASE to WVARA Hamfest, Box 81, Terre Haute IN 47808.

WARREN 17TH

The 17th Annual Warren Amateur Radio Association Hamfest will be held at the Yankee Lake Amusement Park in Yankee Lake OH, on Sunday, August 18, from 9:00AM-6:00PM EDST. For more information contact: R. Drew Kelley W8GFG, 822 Moore Street, Hubbard OH 44425. Phone: 216-534-3376. Bus. Ph. 216-448-6801, Ext. 393.

HAMILTON – HAMILTON

Q.T.H. – Holiday Inn, Hamilton, Ontario, Canada. Dates – October 25, 26, 27, 1974. There will be eight forums, extensive ladies program, fleamarket, banquet. Everything under one roof. For registration forms write: P.O. Box 836, Burlington, Ontario, Canada.

STRICTLY CINCY

This year the 37th Annual Cincinnati Hamfest will again be sponsored by the Greater Cincinnati Amateur Radio Association and will be held on Sunday, September 15, 1974, at the new Stricker's Grove located on State Route 128, two miles west of Ross (Venice), Ohio, north of Cincinnati. For more information contact: Greater Cincinnati Radio Association, 3965 Harmar Ct., Cincinnati OH.

MONTREAL '74

The 1974 Montreal Hamfest will be held August 4, at the MacDonald College Farm, Ste Anne de Bellevue. Prizes, Giant fleamarket, technical sessions, family fun, $2.50/adult. For more information contact: VE2RM, Box 201, Pointe Claire-Dorval, Quebec H9R 4N9.

OH! ADRIAN

The Adrian Amateur Radio Club will hold a Hamfest on October 13, 8:00AM – 3:00PM at the Lenawee County Fairgrounds in Adrian MI. Tickets $1 in advance, $1.50 at gate. Flea market, trunk sales, large display area – table $3 – half $1.50. Ample parking. prize drawing every hour. Grand prize drawing 3:00PM. Talk-in 146.46-.52-.94MHz For more information contact: Adrian Amateur Radio Club, Box 26, Adrian MI 49221.

ANGOLA FEST

The original FM hamfest Sunday August 4, 1974, near Angola, Indiana. Free flea market, entertainment for ladies and kids. Picnic grounds, campsites, boating, food, soft drinks, available, rain or shine. For information contact: Fort Wayne Repeater Assoc., Box 6022, Fort Wayne IN 46806.

20TH VHF

The 20th Annual VHF Conference will be held at Western Michigan University, Kalamazoo MI, on October 19, 1974. There will be Swap 'n Shop, Technical Forums, Evening Dinner, etc. For details please write: VHF Conference, S.M.A.R.S., P.O. Box 934, Battle Creek MI 49016.

GRAND EVENT

The Grand Rapids Swap and Shop will be held Saturday, September 21, 1974 at the Hudsonville Fairgrounds, M-21 at 40th Street, three blocks west of the Hudsonville traffic light. Admission is $1.75 at the gate, no charge for tables or trunk sales. Talk-in on .16/76 and 146.94. For more information contact: Grand Rapids Amateur Radio Association, Inc., P.O. Box 1333, Grand Rapids MI 49501.

LOUISVILLE BASH!

The 4th Annual Greater Louisville Hamfest will be held at the Oldham County Fairgrounds, LaGrange KY, on Sunday, August 25, 1974, from 8:00 AM until 6:00 PM. For more information contact: Denny Schnurr K4GOU, 1022 Sylvia St., Louisville KY 40217 or telephone 502-634-0619 (home); or 502-774-7549 (work) leave message.

THE L'ANSE CREUSE ARC

The L'anse Creuse Arc will open the fall season for swap 'n shops in the Detroit area on September 22, 1974, EDT 9:00 – 3:00 at L'Anse Creuse Central Jr. High School, main drawing 3:00, 3800 Reimold Rd., Mt. Clemens MI. Free parking, good food, prizes, tables $1.00. Admission $1.00. Talk-in on .94; For more information contact: L'anse Creuse Arc, 38024 N. Bonkay Dr., Mt. Clemens MI 48043.

MILWAUKEE FEST
(Bastille Day Celebration)

South Milwaukee Amateur Radio Club 4th annual Southeastern Wisconsin Swapfest will be held Saturday, July 14, 1974 at Shepard Park (American Legion Post 434), 9327 South Shepard Avenue, Oak Creek WI. Activities begin at 7:00AM and will run to 5:00PM or later. Parking, picnic area, hot and cold sandwiches and liquid refreshments will be available on the grounds. Admission is $1.00 and includes a "Happy Hour" with free beverages. Prizes will be awarded. Talk-in on 146.94MHz. More details available from: So. Wilwaukee Amateur Radio Club, S.F. Schreiter W9AKF, Secretary, 104 Brookdale Drive, South Milwaukee WI 53172.

INTERNATIONAL HAMFEST

The 11th Annual International Hamfest will be held July 13 and 14, at the Canadian Pavilion in the International Peace Garden between Dunseith ND, and Boissevain, Manitoba. Camping excellent. Party – Contest – Prizes – Meetings. For information contact: Ken Larson KØPVG, 807 Kelly Ave., Devils Lake, ND 58301, or Ron Samchuk VE4SR, 834-9th St., Brandon, Man.

"INDY" 14
(Another Bastille Day Bash)

The Greater Indianapolis Hamfest will be held on Sunday July 14, 1974 at the Marion County Fair grounds on the South East side of Indianapolis at the junction of Interstates 465 and 74. All events including the giant flea market will be under roof. Thirteen area amateur radio clubs combine to bring central Indiana an outstanding convention of technical forums, commercial displays and fellowship. Complete food facilities. Free coffee and donuts in the morning. Gates open at 6:00AM. $2.00 at the gate entitles the bearer to hourly and main prize drawings. There will be a presale ticket drawing for a Genave transceiver. The main prizes consist of an impressive array of low band and 2m Drake gear. There is a good restaurant on the grounds. Free prizes for the kiddies and a full schedule of women's activities.

UPPER PENINSULA HAMFEST

August 3 & 4, 1974, Negaunee Township Hall, Negaunee MI. Hiawatha Amateur Radio Association host. Registration $2. Swap n' Shop, Program for XYL's, Door prizes. Mobiles talk in on 3.920 and 146.94. Reservations and info: Frank K4CGQ/8, 322 Fortress, Sawyer AFB MI 49843. 906-346-5501.

MAPLE RIDGE

The Maple Ridge Amateur Radio Club is sponsoring a hamfest in honor of the Centennial of Maple Ridge, British Columbia, Canada, on July 13-14, at the Exhibition Grounds in Maple Ridge B.C. Registration $2, 12 and under free when accompanied by parents. D.D.C. providing Enforcement Van for frequency checks, and lecture on topical subjects; Swap & Shop, CW, Bingo, 2m Bunny Hunt on 147.33, Ladies program, Kids games, Prizes and more. Talkin on 3.755, 147.33, 146.76 and 34/94. Limited on site camping or trailering. For more information or advanced registration or assistance with accomodations write to Bob Haughton, President M.R.A.R.C., 20623 114 Ave., Maple Ridge, B.C.

WARREN HAMFEST

Largest family style hamfest in the east. Sunday, August 18th at Famous Yankee Lake Park. Giant Fleamarket, swimming, picnicing: all free. Details QSL W8VTD.

"INDY" 14

Greater Indianapolis Hamfest, Sunday, July 14, 1974, rain or shine, Marion County Fairgrounds, all activities under roof. $2 covers gate fee and prize drawing. For information write: Wm. J. Evans, 8104 Crest Hill Drive, Indianapolis IN 46256.

McKEESPORT SOCIAL

The Two Rivers Amateur Radio Club of McKeesport PA will hold its 10th annual Hamfest on Sunday, July 21, 1974, at the Green Valley Fire Department grounds off the East Pittsburgh-McKeesport Blvd., near U.S. 30. Check in on 29.000MHz. For information contact: Jim Hill WA3FSH, 2500 Banker Street, McKeesport PA 15132.

OKLAHOMA HAM HOLIDAY

The Oklahoma Ham Holiday will be held Saturday and Sunday, August 3 and 4 in Oklahoma City. In addition to the largest fleamarket in the Southwest the program will include special speakers, technical seminars, equipment displays, MARS meetings and unique activities for the XYL. Overnight parking for recreational vehicles is available. For more information and advance registration write Central Oklahoma Radio Amateurs, Inc., P.O. Box 15013, Oklahoma City OK 73115.

ZERO-BEATERS A.R.C. HAMFEST

August 4, 1974, Washington MO City Park. It starts at 10AM CDST, Auction at 11AM. Attendance prizes and other goodies. Auction, free bingo for XYL, cake walk, candy scramble – gigantic traders row. For Hamfest information and tickets write or contact Zero-Beaters ARC, Box 24, Dutzow MO 63342.

FT. WAYNE ORIGINAL

The original FM Hamfest sponsored by the Ft. Wayne Repeater Association WA9EAU, will be held Sunday, August 4, 1974 at the Steuben County 4H Fairgrounds off the Lake James Crooked Lake interchange of I-69 3 miles of Ind. Tool Rd. 80-90. Gate and flea market, open 0600-1600, free coffee & donuts 0600-0800. Admission $2.00 includes main prize drawing. Children under 12 – free. Talk in – 16/76–94/94.

NINTH SWAPFEST

The ninth annual Northwest Texas Emergency Net Picnic & Swapfest will be held at the City Park in Levelland, Texas on Sunday, August 11, 1974. Bring your own picnic basket. Free registration begins at 0900. Lunch at 1300. Swapping all day. This event is for the entire family. Mobile talk in frequency is the net frequency 3950kHz and 28/88, 34/94 on 2m.

MELBOURNE HERE I COME

The 9th annual Melbourne Hamfest is September 7-8. All air conditioned, $1.50 at door. Tables $2/day. PCARS, P.O. Box 1004, Melbourne FL 32901.

GLACIER FEST

On the weekend of July 20 and 21, 1974 the WATERTON GLACIER INTERNATIONAL HAMFEST will be held in the beautiful Waterton Lakes National Park. For more information contact: John A. Fyke VE6AIV.

Bill Pasternak WA2HVK/6
14732 Blythe Street #17
Panorama City CA 91402

I believe it began: "Space, the final frontier." Memorable words from a memorable television program, "Star-Trek." I guess that I am what is known in SF (science fiction) circles as a "trekkie," one who tried never to miss an episode or rerun of that "series" that took one's mind into the future on voyages light years from home. I guess that I was not alone if the reports about ECLICON-'74 are what I hear. ECLICON is the yearly convention held in LA where devotees of the world of Star Trek gather much like our "HAMventions." We swap rigs and look at all the new goodies; they swap stories about what's what in the SF world and browse through the memorabilia of this now almost historic television series. I wanted to attend this year almost as much as I want a new HT220, but neither were possible. Thanks, though, to Pacifica radio station KPKF, a show thereon called "Hour 25" and its host Mr. Mike Hodel, I was there at least in spirit. Through Mike's eyes and voice, I was able to browse a bit while driving my mobile up the San Diego freeway; one of those times when the rig was turned off and the other FM radio was in use.

Well, Star Trek is gone except for the stations that still carry it in syndication. Perhaps it was killed off by the real thing; live television from space and from the moon. And, even more recently, those marvelous pictures sent back to old mother earth by NASA's Mariner Venus/Mercury probe. Amateur radio had its small part in the success of this mission; namely in those hams at the Jet Propulsion Laboratory here in Pasadina and at Boeing Aircraft in Renton WA who were part of the team of scientists, engineers and technicians working the project.

To celebrate the success of this mission, amateurs belonging to the Boeing Employees Amateur Radio Society and the Jet Propulsion Laboratory Radio Club offered a special QSL to any amateur worked by either WS6MVM or WS7MVM respectively. I was one of those lucky ones who worked Warren Andresen WA6JMM, under the WS6MVM callsign via the Mt. Lee Repeater, WR6ABN. So that we VHFers could partake of the festivities Warren supplied both the time and the 2m rig. In the process he handed out to we VHFers a considerable number of these "Special Event" QSLs; a job to which we here in LA thank him and the JPL club for their efforts.

Since we started discussing the media (i.e. television & radio) I would like to put my two cents in at this time about the February 7, "Chopper One." First, why wait till now? Simple, the first time around I did not see the program. I share something in common with that date in that February 7 is my birthday and though I had read the TV Guide blurb on the show, we had other plans for that evening. However, I knew if I waited long enough, ABC would run it again.

I was not to be disappointed. Last Thursday it was repeated and I sat glued in front of my TV watching the plot unfold. I have but one question for ABC and the producers of *Chopper One*. Why with as many hams working for ABC in LA was it not possible to ask one to act as technical advisor for the episode? Now if K6XEG were running a 450 MHz Base Radio, some of us might have believed that he had procured crystals for the Chopper's frequency and as Wayne put it "zapped onto the police radios." I've yet to see a dc Band station that can pull that trick. And that was a neat stunt hearing the bad guys on their CB walkie talkies halfway across town in a city where every 11m channel is 25 layers thick 24 hours a day. My advice to the media is use us, but don't abuse us. If you ask our help in producing something dealing with amateur radio many of us would consider it an honor to participate. But, for heavens sake don't make us out to be demented nitwits and foolish children. If one wants to figure numbers, that little fiasco probably cost ABC some 280,000 amateurs and God knows how many million CB operators as potential future audience. Let's face it, in the ratings game that's quite a hunk of viewership.

Therefore, I take it upon myself to make the following offer to ABC, NBC, CBS or any other LA station planning productions that involve amateur radio. If you need technical advice as to what will look right please contact me. If I cannot help you myself, I will do my best to put you in contact with an amateur; perhaps one working for your station or production company that can fulfill your needs. That particular *Chopper One* episode is a thing of the past and best forgotten by all concerned, but none of us want a repeat of this type of thing somewhere else next season. Well, one good thing, at least the "bad guys" were on the band where they belonged.

The "oops we goofed department" or to err is human to forgive devine. In May we mentioned a repeater in the Stocton area under the call WR6ACB. Well, that was a 3AM typographical error on my part. In a letter from Bill K6ZQ, I learned that my writing that column at that absurd hour had put WR6ACB about 400 miles north of where it belongs in La Habra Heights and on the wrong channel. WR6ACB is a Los Angeles area repeater on 19-79, owned by the Anaheim Amateur Radio Association of which Bill is president, and serves the Orange County area. With my buddy John WA2FMF/6, now a resident of Brea it might just pay to dig out my 19/79 rocks and put them back in the Sonar 3601 mobile. It's a good hour ride from here in the SF Valley to that area. I will give you the correct call for the Stocton machine next month. In the interum my apologies to both groups.

WA2HVK/6

Tom DiBiase WB8KZD
708 6th Avenue
Steubenville OH 43952

Contest Calendar

July 27-29	CW County Hunter's Contest
Aug. 3-5	Kentucky QSO Party
Aug. 17-18	New Jersey QSO Party
Aug. 17-18	QRP ARC Contest
Sept. 14-16	Pennsylvania QSO Party
Sept. 14-16	Washington State QSO Party
Sept. 28-30	Delta QSO Party

This Month

CW County Hunter's Contest

From 0000Z July 27 to 0600Z July 29. Call CQ CH, exchange QSO number, category (portable or mobile, P or M), RST, State or province or country and county. Stations may be worked once per band and again if a county change was made. Scoring – QSOs with fixed stations are one point, with P or M stations – three points. Multiply points by U.S. counties worked. P&M stations calculate score on basis of total QSOs within a state. Frequencies 3575, 7055, 14070, 21070 and 28070. Appropriate awards. Logs must show category, date/time GMT (UTC), stations worked, exchanges, band, QSO points, location and claimed score. 100 or more QSOs require check sheet (of counties worked). SASE for results. Must be postmarked by September 1, and sent to CW County Hunters Net, c/o Jeffrey P. Bechner W9MSE, 64 North Pioneer Parkway, Fond du Lac WI 54935.

August

New Jersey QSO Party

From 1900Z August 17, to 0600Z August 18. Second period is from 1200 to 2300Z, August 18. Phone and CW are same contest. Stations may be worked once per band/mode. Frequencies – 1810, 3535, 3735, 3905, 7035, 7135, 7265, 14035, 14280, 21100, 21355, 28100, 28600, 50-50.5, 144-146. Exchange QSO number, RST and QTH (ARRL section or country). New Jersey stations send county. Multiply total QSO points by total different QTHs worked. New Jersey stations score one point for W-VE QSOs, three points per DX QSO. Non-New Jersey score one point per New Jersey QSO. (For New Jersey, the KP4, KH6, KL7, KZ5 count both as DX and ARRL sections (4 points). Appropriate awards. Logs should include GMT (UTC) date/time, band, mode, and must be received no later than September 14. The first QSO for each claimed multiplier must be numbered and check list of QSOs and multipliers should be attached. Multi-operating stations include all calls of participating operators. Comments welcome. Send to Englewood ARA, Inc., 303 Tenafly Road, Englewood NJ 07631. #10 SASE for results. Stations planning active participation in New Jersey are requested to advise EARA by August 3, so they can plan for full coverage from all counties. Portable/mobile operation encouraged.

WB8KZD

J.O.T.A. '74

The 17th Annual Jamboree-on-the-Air, will be held October 19-20. Suggested starting time is 0001 hours LOCAL TIME on Saturday, October 19, and terminating 48 hours later, i.e., at 2359 hours LOCAL TIME on Sunday, October 20. Note that these are only suggested times, if it is more convenient for your stations to operate on the Friday evening, then you are perfectly free to do so.

HAM HELP

This column is for those needing help in obtaining their amateur radio license.

If you are interested, send *73* your name, address and phone number. Don't be bashful – remember, it's always easier when you have someone to give you that added bit of confidence.

73 would appreciate amateurs and clubs looking this list over and helping whoever they can. Do you remember when you needed help?

Aaron Jackson Jr.
P.O. Box 123
Clinton NC 28328

James D. Guy K7UAN
5818 S. 21st Dr.
Phoenix AZ 85040

Robert Bryan
P.O. Box 71
Cockeysville MD 21030
Telephone: 301-666-8453

Bishop L. Ellison
P. O. Box 631
West Branch IA 52358

NEW PRODUCTS

DYCOMM SUPER "D"*

Some months back, Dycomm ran a full page ad in several of the ham journals advertising a special "while they last" kit offer for their Super "D" amplifiers at an amazing low price of $49.95, which is less than the commercial price of the transistors supposedly used in the device alone. Apparently Dycomm had a goodly supply of these units stashed away, for the price was recently raised to $59.95 and they are still being offered. Dan WA1EYX, got one of these units, and I hoped for a chance to see it, and evaluate what appeared to be one of the better deals in a long time. The opportunity soon came, for shortly after completing the kit, Dan was having troubles in tuning it up, and we both set it up on the bench for a few measurements.

Technically, the amplifier is self-contained, requiring only 13.6 VDC and rf drive to operate. It is automatically switched into the line when it senses rf, and does not need an external keying line. Two transistors are used in a parallel arrangement. The transistors supplied were unmarked and manufactured by Dycomm. They were supposedly equivalent to the excellent Motorola 2N6084 types which are each rated at 40 watts out and have ballasted emitters for infinite VSWR protection. All parts, including a nice glass epoxy board were supplied with the kit. This unit has no low pass filter after the amplifier stage, an obvious shortcoming since with typical low-Q circuits used in the low-impedance high-current output network, harmonic content is probably no better than 25 dB down referenced to the carrier. This amp will be best used if installed in a fast mobile with an inconspicuous antenna.

Several other design shortcomings were evident. With more than 20 watts of drive, the ferrite beads used in the DC return chokes for the transistor base biasing saturated, overheated and smoked. The ordinary dipped silver-mica capacitors were originally used in series with the inductors feeding the extremely low input impedance of the transistors; these high rf currents caused dielectric heating of the capacitors, resulting in continual shift in tuning and eventual breakdown. The diode supplied to sense rf turned out to be a silicon power type and would not detect two meter rf energy; this had to be changed. The relay used for rf switching is an open frame type, and is apparently quite reactive at 146 MHz. Dycomm uses a series capacitor on the rf output circuit to tune out the reactance, but we were unable to obtain less than a 2 to 1 SWR between the exciter and amplifier. When operating straight through the amplifier, the relay is still in the circuit, and the capacitor must be re-tuned to obtain reasonable SWR.

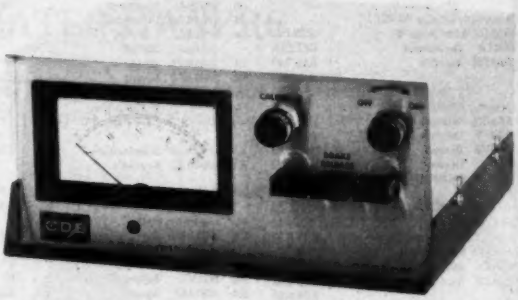
Dycomm claims over 80 watts out with 30 watts drive, and 70 watts out with 20 watts in as being "typical" figures. Using two Bird 43 Wattmeters, our figures showed 50 watts out with 30 watts in. The heatsink used is minimal, and short transmissions must be the rule. We were unable to make further evaluations due to the failure of one of the output transistors, and sent the unit back to Dycomm along with their fifteen dollar "we'll fix it for ya" fee, and a letter describing the problems. It came back with better caps and new transistors, and was now putting out 60 watts with 30 in, still below advertised claims. After one week of mobile operation, it is again out of service with defective transistors.

We must give this amplifier an unfavorable report; this is regretable for it had the makings of a real good deal. Perhaps these design and manufacturing flaws were caused by component substitutions at Dycomm in order to meet demand, and if the problems are resolved we will report it in a future issue of INTERMOD. We understand several others have had experiences closely in line with ours with their *"Super Dud"* also.

Reprinted from Intermod.

John K1ZJH

NEW CDR ROTOR



The new CDR Ham-II antenna rotating system has an important advantage over the older Ham M units in that the new control unit has a separate switch for operating the brake.

The inertia of larger antenna systems is a force that has to be considered. The sudden stopping of the brake action on the Ham-M units put severe stresses on the rotors, the towers, the tower guys, the antennas themselves. Something has to give eventually when repeated stresses like this are present. The new control unit permits the antenna to be turned and allowed to coast to a stop rather than slammed to a halt, whipping the tower and beam around.

The amateur net price of the complete Ham-II system is $150, with the control unit being available separately for about $80 — and it will work with any of the Ham-M rotors.

SAVE THAT RIG

The life expectancy of a good ham mobile rig left unattended in a car on the streets of New York is about 20 minutes. In Chicago it is about 40 minutes — and almost an hour in Boston, on the averagj . It is prudent to make every effort to protect your investment, not only with some sort of alarm system, but with the best locking device you can get — something that will keep the rig in the car even if a burglar manages to get into it — and they can manage.

Keeps-It Kit has a new bracket for your rig — a tamper-proof one. Normal tools such as screwdrivers, vise grips, allen wrenches, etc., are ineffective against the mighty grip of the Keeps-It. Models are available for the SBE, the Regency, and the Genave so far - with more to come. The price is only $16.

Before you take this lightly, call your insurance agent and see if you are insured against the loss of your mobile rig - and to what extent — and how about the second and third theft? Lordy, they even rip the rigs out in parking garages these days.

Details on Keeps-It Kit are available from *Jim Wallace K5SOY, Box 13249, Ft. Worth TX 76118.*

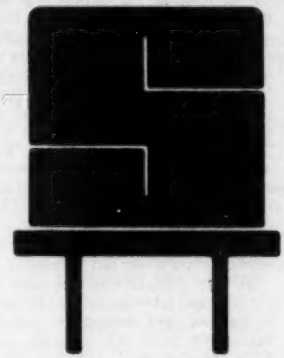
repeater update

Revision of Recently Published Repeater Atlas

AL	WR4AEJ	Birmingham		6.28-6.88
AL	W4MWF	Montgomery		DELETE
AL	WR4AGA	Mt. Cheaha		6.16-6.76
AL	WR4AGN	Opelika		6.34-6.94
			W1.8	52.760-52.525
	(Formerly:	W4ZBA)		
AL	WR4AEH	Tuscaloosa		6.22-6.82
AZ	WR7ACK	Sierra Vista		6.16-6.76
	(Formerly:	WA7KYT)		
AR	WR7ACT	Eagle River		6.16-6.76
				6.16-6.76
				448.2-444.2
AR	WR5ADI	Little Rock		6.34-6.94
	(Formerly:	W5DI)		
CA	W6IWY	Canoga Park		7.06-7.06
CA	WR6AAA	Catalina Island		7.09-7.09
	(No PL)			
CA	WR6ACJ	Crestline		6.25-6.85
	(Erroneously listed as WR6ACI)			
CA	WA6LNU	Los Angeles (AM)		222.20-223.00
CA	WA6NTW	Los Angeles		222.34-223.94
CA	WR6ABI	Los Angeles PL		7.09-7.09
		(Hollywood Hills)		223.20-224.80
CA	W6NWG	Orange Co.		6.13-6.73
		(Mt. Palomar)		
	(Erroneously listed as WENOG)			
CA	WR6ADR/6	San Bruno Mt.		7.90-7.30
CA	WA6ILA	San Joaquin		DELETE
CA	WR6ACM	Vacaville		6.55-7.57
				52.760-52.525
				449.85-444.85
	(Formerly:	WB6WYI)		
CO	WA6BAG	Colorado Springs		DELETE
CO	WA6VTV	Colorado Springs		6.16-6.76
CO	WA6WVU	Denver		444.90-449.90
CO	W6TX	Denver		444.35-449.35
	(Formerly:	WA6VVC)		
CO	WR6ABB			444.65-449.65
CT	WR1ACZ	Norwalk		7.99-7.39
CT	WR1ABC	Torrington		223.60-224.80
DE	WR3ABA	Wilmington		6.13-6.73
	(Formerly:	WA3FRH)		
DE	WR3ACV	Wilmington		7.75-7.15
FL	WR4ACV	Boca Raton		6.22-6.82
				6.34-6.94
	(Formerly:	WB4KVV)		
FL	W4LRH	Ft. Myers		6.28-6.88
FL	WR4AAF	Jacksonville		6.16-6.76
				52.760-52.640
	(Formerly:	WB4QFL)		
FL	WR4AEG	Melbourne		412.8-448.8
FL	WB4KBG	Melbourne		6.25-6.85
FL	WR4API	Merritt Island		6.28-6.88
				6.34-6.88
	(Formerly:	WB4KNQ)		
FL	W4MKD	Miami		CLOSED
FL	WR4AFO	Orlando		6.16-6.76
				6.34-6.76
	(Forhorly:	WB4QEL)		
FL	WR4AEG	Orlando		6.58-7.18
				7.78-7.18
FL	WB4QER	Panama City		6.16-6.76
FL	WR4ADL	Pensacola		6.07-6.67
FL	WB4KNS	St. Petersburg		CLOSED
	(Formerly:	WB4IES)		
FL	WB4AFJ	Tampa		CLOSED
GA	WR4ABJ	Athens		6.13-6.73
GA	WB4NST	Atlanta		DELETE
GA	WR4ABI	Atlanta PL 103.5		6.04-6.64
GA	WR4ADS	Atlanta		444.50-449.50
	(Formerly:	WB4OGF)		
GA	WR4AED	Atlanta		6.16-6.76
	(Formerly:	WB4WST)		
GA	WR4AEW	Atlanta		7.90-7.30
		(Sandy Springs)		
GA	WR4AFC	Atlanta		6.01-6.61
GA	WR4AFR	Atlanta		7.66-7.06
GA	WR4AQD	Augusta	T1.95	6.34-6.94
				7.90-7.30
	(Formerly:	WB4KLM)		
GA	K4DVJ	Dallas		6.25-6.85
GA	WR4AEK	Gainesville		6.07-6.37
		(Wafka Mt.)		
GA	WB4CNC	Griffin		DELETE
GA	WR4AEA	Griffith		6.43-7.43
GA	W4RRW	Smyrna		DELETE
GA	WR4AED	Stone Mt.		6.16-6.76
	(Formerly:	W4BOC)		
HI	KH6EQF	Honolulu		6.28-6.88
				448.15-444.15
HI	KH6EQR	Lualualei		DELETE
HI	WR6ACL	Waikiki		6.16-6.76
	(Formerly:	KH6FOX)		
HI	KH6NLH	Waipahu		DELETE
IL	WR9ACE	Aurora		CLOSED
	(Formerly:	WA9EAW)		
IL	WR9ABY	Chicago		6.16-6.76
		PL		448.75-443.75
	(Formerly:	WA9ORC)		
IL	WR9AOZ	Chicago PL		7.15-7.45
IL	WA9WJG	Danville		DELETE
IL	WR9AAA	Joliet		6.22-6.82
	(Formerly:	WA9EAT)		
IL	WR9AAD	Murphysboro		6.25-6.85
IL		Springfield		6.28-6.88
IL	WA9WVB	Urbana	T2.25	6.34-6.76
IN	WA9EAU	Ft. Wayne		6.16-6.76
				6.31-6.91
IN	WR9ABN	Ft. Wayne		6.28-6.88
IN	WB9FHD	Freemont		DELETE
IN	WB9RAI	Indianapolis		DELETE
IN	WR9ACU	Indianapolis		6.28-6.88
IN	WR9ACZ	Lafayette		6.16-6.76
	(Formerly:	WB9EJY)		
IN	WR9ACX	Marion		6.19-6.79
IN	WA9ABO	Muncie		6.13-6.73
IN	WR9ABQ	Pittsburg		DELETE
IN		Wabash Valley		6.25-6.85
KY	W4YWH	Covington		6.13-6.73
				6.19-6.79
KY	WR4AEM	Independence		7.66-7.25
KY	WB4RYX	Louisville		
LA	WR5HCC	New Orleans	T1.8	6.16-6.76
				6.34-6.94
	(Formerly:	W5UK)		
LA	WR5ADB	Roybilo		6.16-6.76
	(Erroneously listed as Boyville)			
LA	WR5ACV	Shreveport		6.16-6.76
MD	W3ENT	Baltimore		DELETE
MA	WR1ACP	Agawam		6.40-7.00
	(Formerly:	WA1MDS)		
MA	WR1ACB	Bellingham		7.60-7.06
MA	WR1ADF	Bridgewater		7.78-7.18
MA	W1ACM	Stoughton		6.775-6.175
MI	WA8BDD	Clarkston		6.25-6.85
MI		Detroit RTTY		6.22-6.82
MI	WR8ABN	Detroit		449.00-444.00
	(Formerly:	WB8CRK)		
MI	WA8PUD	Grand Rapids		DELETE
MI	WR8ACN	Grand Rapids	T2.25	6.16-6.76
	(Formerly:	WB8IE)		
MI		Howell		7.63-7.63
MI	WB8CSU	Jackson		DELETE
MI	WB8CQM	Lansing		6.22-6.82
				6.34-6.94
MI	WB8CRQ	Manistee		6.19-6.79
MI	WR8AAA	Milford		6.19-6.79
MI	WR8ACS	Rochester		
MI		Town		6.34-6.94
MI	WB8FGB	Tawney		6.16-6.76
MS	WR5ADC	Gautier		6.28-6.88
	(Formerly:	WA5RMS)		
MO	WR9ABW	Kansas City		448.10-448.10
	(Formerly:	K8OKI)		
MT	W7YB	Bozeman		6.28-6.88
NE	WR9ACD	Beaver Crossing		6.16-6.76
	(Formerly:	WA8VWD)		
NE	K8YRL	Lincoln		6.34-6.94
NJ	WR2ABJ	Cedar Grove		7.78-7.18
NJ	WR2ADV	Paramus PL 141.3		6.19-6.79
				443.1-448.1
	(Formerly:	WA2UWR)		
NJ	K2GCL	Waldwick		DELETE
NM	WA5QLZ	Albuquerque		DELETE
NM	WR5ACX	Albuquerque		6.16-6.76
NM	WR5ABV	El Capitan		6.34-6.94
	(Formerly:	WA5DMG)		
NM	WR5ABU	Los Alamos		6.28-6.88
	(Formerly:	W5PDG)		
NM	WR5ACM	Mt. Taylor		6.34-6.94
	(Formerly:	WA5JOZ)		
NM	WR5ACE	San Antonio Mt.		6.16-6.76
NM	WA5VKY	Sandia Crest		6.13-7.00
NY	WB2GDF	Brooklyn (CLOSED)		7.90-7.30
NY	WR2ABH	Dick's Hills (CLOSED)		7.90-7.30
		L.I.DXA		
NY	WR2ABL	Elmira		6.16-6.76
NY	W2AWG	Flushing		DELETE
NY	WR2ACK	Gloversville		6.16-6.76
NY	WR2AAA	Manhattan		7.73-6.73
NY	WR2ACV	Manhattan		7.43-6.43
	(Formerly:	WA2ZWP)		
NY	WR2ACU	Rochester		6.07-6.67
NY	WR2ADG	Rochester		448.25-444.25
NY	WR2ABO	Rome		7.78-7.18
NY	WR2ADN	Saratoga		6.40-7.00
NC		Asheville		6.31-6.91
NC	WR4AGF	Asheville		6.22-6.82
	(Formerly:	WA4NUO)		
NC		Burlington		6.07-6.67
NC	W4HBR	Goldsboro/Kingston		DELETE
NC	WR4AFV	High Point		6.19-6.79
OH	WR8ABT	Chesiet		DELETE
OH		Cincinnati		6.16-6.76
OH		Cincinnati RTTY		7.69-7.09
OH		Cincinnati		7.75-7.15
OH	WR8ABT	Cincinnati		6.07-6.37
	(Formerly:	K8SCH)		
OH	WR8ACB	Cincinnati		6.115-6.70
	(Formerly:	WB8NON)		
OH	WR8ACC	Cincinnati		7.99-7.39
OH		Cleveland		6.25-6.85
OH	WR8ABO	Cleveland		6.34-6.94
	(Formerly:	KB8MM)		
OH	WB8CRP	Cleveland		6.22-6.82
	(Formerly:	W8TTO)		
ON	WR8ACR	Cleveland		6.13-6.73
ON	WR8ABV	Columbus		6.16-6.76
	(Formerly:	WB8WTS)		
ON	WR8ACZ	Dayton		442.85-447.85
OH	WA8GEC	Fairfield		6.13-6.73
OH	WB8ABW	Galion		6.25-6.85
	(Formerly:	K8ZES)		
OH	WR8ACW	Lima		6.34-6.94
OH	WR8ACQ	Mansfield		6.34-6.94
OH	WR8ABM	Marietta		6.28-6.88
	(Formerly:	W8HH)		
OH	K8PWL	Miamisburg		DELETE
OH	WR8ABS	Middletown		6.01-6.61
	(Formerly:	WB8ATD)		
OH	WR8ABX	Newark		6.28-6.88
OH	WB8CGO	Toledo		DELETE
OH	WR8ACT	Toledo		6.19-6.79
				6.34-6.94
OH	WR8ADC	Toledo		6.01-6.61
	(Formerly:	K8ALB)		
OH		Troy		DELETE
OH	WR8ACX	Warren		6.37-6.97
OH	WB8DO	Youngstown		DELETE
OK	WR5ADE	Oklahoma City		6.34-6.94
	(Formerly:	WA5YTI)		
OK	WR5ADF	Oklahoma City		6.86-6.67
PA	WR3ABC	Allentown		6.34-6.94
	(Formerly:	W3OI)		
PA	WR3ACD	Chambville		6.40-7.00
				222.59-224.59
PA	K3ZTP	Coatsville		DELETE
PA	WA3KXD	Erie		DELETE
PA	WR3ACO	Harrisburg		6.16-6.76
PA	WR3ACS	Johnstown		6.34-6.94
PA	WR3AAB	Lehigh Valley		6.16-6.76
	(Formerly:	W3OK)		
PA	WA4BJS	Pittsburgh		6.16-6.76
PA	WA4BJS	Pittsburgh		DELETE
PA	WR3ACH	Pittsburgh		6.22-6.82
PA	W3DV	Philadelphia		7.63-7.83
				29.640-29.493

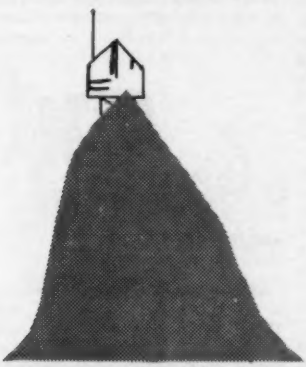
MORE NEXT MONTH

Send any and all corrections, updates or new listings to 73 Magazine, Peterborough NH 03458.



REPEATER OWNERS

Don't Take Chances. SENTRY offers custom made crystals made exactly to your specifications. When it comes to crystals for your repeater, BUY THE BEST – SENTRY.



REPEATER USERS

If you want reliable access to the repeaters in your area, you want and need SENTRY CRYSTALS. SENTRY CRYSTALS are custom made for your rig. We don't stock a large quantity of crystals for a certain frequency and hope you can tweak them to frequency in your rig. We do offer FAST service on crystals made especially for you and your rig. If you want reliable, on-frequency operation, INSIST ON SENTRY.

SENTRY MANUFACTURING COMPANY
Crystal Park, Chickasha, Oklahoma 73018

PHONE: (405) 224-6780
TWX-910-830-6425

Joe Kasser G3ZCZ
1701 East West Highway, Apt. 205
Silver Spring MD 20910

For a country at war, everything appears to be normal. There are one or two minor differences noticeable from peacetime, such as a lack of young men in the streets and no ham operation. The lack of ham operation does not seem to be by government decree, but because all the operators are away in the desert on active service.

The country that I am writing about is Israel, better known as 4X or 4Z. It is an ideal location for ham operation, since it lies right where Europe, Asia and Africa all come together. It is thus possible to work three continents and over sixty countries without any effort at all on the HF bands. The VHF bands also have extremely good propagation conditions particularly in the summer. Evidence of this is clearly demonstrated by the multitude of TV antennas sprouting from nearly every rooftop in sight. TV reception in Haifa and Tel Aviv is such that viewable pictures can be seen from Cyprus, Lebanon, Syria, Jordan and Egypt.

Most of the locals, hams or otherwise, speak some English and they are all very friendly. For those of you who would like to work into 4X without or before going there try listening on or around 21360 MHz after 1600Z. That is the time that I have been able to get through from Washington DC.

If you are like me when mobile with a TR-22 you will have to keep changing crystals when mobile in different parts of the country. I usually talk myself on frequency with the help of one of the locals using the copper bronze clip that holds the plastic cover in place to warp the frequency. WB4JFI who writes the ATV column has a neat modification for putting 12 channels in the TR-22. He uses a switch and strip of crystal sockets obtained from Lafayette CB rig spares. I'll write some more after I've put it in my rig.

There seems to be more and more QRP rigs on the HF bands now. These rigs are ideal for the traveling ham. I worked a DX station the other day on 15, he was using an Argonaut transceiver and a 3 element beam. I worked a number of Europeans that day and his signal sounded just as good as the others. I even heard him in there calling through the others. QRP can do good things for the traveling ham.

If you are going to use QRP it is very important that you also use an efficient antenna such as a matched long wire or a dipole or a beam. Read some of the published material on QRP operation and see what the "pro's" use. You never know, you may end up using QRP at the home station. In fact while I am writing this I am also calling CQ on 80m RTTY using 8W output as indicated on my Heath HM-102 Power Meter. I haven't worked anyone yet but I'm hopeful.

Still for those of you who want to use big rigs, take care when you plug in the line cord, because the rest of the world does not necessary use 60Hz/110VAC lines. In fact more countries use 50 Hz/220V lines than 60/110V. I've found that a shaver transformer is an ideal device for interfacing my TR-22 to 220V lines for recharging.

Next month I'll present a list of line voltages and frequencies for the most commonly visited countries of the world. Until then keep those letters coming, for its only by such reader/writer feedback that I can determine if anyone actually reads this column.

G3ZCZ

Terry Fox WB4JFI
3612 Bancroft View #302
Baileys Crossroads VA 22041

This month I would like to bring up a few questions to all ATVers, and they have to do with that now familiar word: standardization. I feel that it would be very advantageous to our particular mode if we could standardize frequencies and antenna polarization wherever possible. If all of us were on the same frequencies with the same polarization, new hams wouldn't have to worry about what's in use in their particular area, and ATV DX would be feasible. Some people may not like this idea at first, but I know how frustrating it can be to look night after night after night for some ATV activity, only to lose interest simply because of too many variables. Having to move the antenna is bad enough, but when tuning a converter and worrying about polarization are thrown in, well, you need a lot more patience than most of us have. So let's get right down to the meat of the matter.

First of all there is antenna polarization. If we standardize on this and I hope we do, will it be vertical, horizontal or circular? I think that we can drop circular right away, because it's harder to build, not commercially available, and not in widespread use today. So now it's down to horizontal or vertical. Let's start by asking a few questions. Which, if either, has more gain under the same conditions? Which is cheaper and easier to build or buy? Does vertical or horizontal have the most overall advantages? I will have to admit right now that I am biased toward vertical polarization because of my own answers to the above questions.

As far as which works better under identical circumstances, rumor has it that above 300MHz neither out performs the other. I have heard of tests conducted by a branch of the military that showed this, but I haven't seen the results myself yet so I may be wrong. If anyone does have info on this I would appreciate it if they could send me a copy.

From which is easier to get gain? This turns out to be kind of a tricky question. If you're talking about directional gain, it's just as easy in either plane. Most antennas that are available will work both ways, you just have to rotate it 90 degrees if you're not right. The stickler is omni-directional gain. The repeater is what really prompts this question, although omni-directional gain is also advantageous for roundtables, nets and mobile operation. Their are many, many vertically polarized antennas with gain on the market today, mostly because of the FM boom. Horizontal antennas are not only harder to make with gain and omni-directional coverage, they are also much harder to find commercially. That has also answered my question regarding price and availability. Another advantage is that commercial television runs horizontal polarization, so if we went vertical, the chances of TVI would be reduced. In case you're wondering why all the fuss about this, 450MHz isn't like 40 meters where often the difference in using cross-polarization isn't too noticeable. At UHF the difference can be as much as 20dB, or more. That is a lot to make up elsewhere.

I think that says what I feel about polarization, now I would like to hear from you, pro or con, because you are where it counts.

I'm sure this is a very touchy subject to some people, but as I mentioned earlier, it would help us and others getting interested in the long run, particularly if it is done now, before the 450 band gets as busy as 2 meters. Also, again I have my own feelings, which I'll bring up.

When we were first discussing putting up WR4AAG, we had a talk with our area frequency coordinator (he was set up as a mediator because of local 2 meter foul ups), and he told us that two frequencies had been sort of set aside all along the east coast for ATV. They are 439.25 and 427.25MHz. Since there wasn't any local ATV activity, we told him that we were going to try to put up a repeater on them. As it turns out, those are the best frequencies we could have gotten. Between 420 and about 425 MHz, there is some AM and CW activity, around 432 to 435 is some moonbounce and satellite work, and above 445 MHz is mostly FM, so we really lucked out, and got out of everyone's hair.

WB4JFI

NEW ENGLAND REPEATERS

—as of June 1, 1974

146.49	WR1AAF[1]	CT	Oxford
146.61	WR1AAH	MA	Marlboro
	WR1ABT	CT	New Haven
146.64	WR1ABV	MA	Waltham
	WR1ADK	CT	Hartford
146.665	WR1ABR	CT	Stamford
146.67	WR1AAI	MA	Boston
	WR1ABD	CT	Groton
146.70	WR1ACW	RI	Providence
	W1MTV	MA	Westfield
146.73	WA1KHC	MA	Mt. Lincoln
	WA1KGP	ME	Sanford
146.745	WR1ACR	MA	Somerville
146.76	WR1ACA	VT	Ascutney
	WR1ACE	RI	Lincoln
	WR1ADB	MA	Fall River
146.775	W1ACM	MA	Stoughton
146.79	WR1ACO	MA	Malden
	WR1ABI	MA	Fall River
	WR1ADJ	CT	Vernon
146.82	WR1ABA	CT	Simsbury
	WR1ABJ	MA	Weston
146.835	WR1ACD	CT	Monroe
146.85	WR1ABQ	NH	Derry
	WR1ADL	CT	Torrington
146.88	WR1AAC	MA	Salem
	WR1ABM	CT	Avon
	W1ABI	VT	Killington
	WR1ABG	MA	Webster
	WR1ACJ	RI	Providence
	WA1KGZ	ME	Buckfield
146.895	WR1ABE	CT	Bridgeport
146.91	K1FFK	MA	Greylock
	WR1AAA	MA	Malden
146.94	WR1ABU	NH	Concord
	WR1ABX	MA	Holyoke
	WR1ACI	ME	Bangor
	W1KOO	VT	Mansfield
	WR1ADD	RI	Providence
146.97	WR1ABF	NH	Salem
	WR1ABO	MA	Worcester
	WA1KGB	CT	Farmington
146.99	W1UQ	MA	Boston
147.00	WR1ACP	MA	Agawam
	WR1ACQ	NH	Deerfield
147.03	W1QFO[2]	MA	Marlboro
	WA1KFZ[3]	MA	N. Adams
147.06	WR1ACB	MA	Bellingham
	WR1ACN	NH	Londonderry
147.075	WR1ACU	MA	Reading
147.09	WR1ABN	MA	Walpole
	WR1ACY[4]	CT	Glastonbury
147.12	WR1ABP	MA	Maynard
	WR1ADN	CT	Fairfield
147.15	WR1ABB	MA	Framingham
147.165	WR1ACL	NH	Salem
147.18	WR1ADF	MA	Bridgewater
	WR1ADM	CT	Naugatuck
147.21	DL2AA/WR1	MA	Medway
147.27	None		
147.30	WR1ACT	MA	Scituate
147.33	None		
147.36	WR1ACH	MA	Newton
	WR1AAD	CT	Canton
147.39	WR1ACC	MA	Oxford
	WR1ACZ	CT	Norwalk
147.42	WR1ADC[3]	MA	Somerset

1. 147.49 input
2. 147.87 input
3. 146.43 input
4. 145.47 input

All input frequencies are 600 kHz (0.6 MHz) below the output channels listed here from 147.03 to 147.39 MHz. I.E., you transmit on 146.01 MHz to use a repeater you can hear on 146.61 MHz.

FCC NEWS

Adopted: April 2, 1974
Released: April 4, 1974

1. Because of recently adopted changes in the Table of Frequency Allocations in Part 2 of the Commission's Rules certain variances exist between the information contained in the Table of Frequency Allocations in Part 2 and the Authorized Frequency list, Section 97.61, of the Amateur Radio Service Rules.

2. This Order is issued to conform the information in Part 97 with the information contained in Part 2 relating to frequency allocations.

3. Because this amendment relates to editorial revisions to effect consistency among the Commission's Rule parts, prior notice of rule making public procedure and effective date provisions are unnecessary, pursuant to the Administrative Procedure and Judicial Review provisions of 5 U.S.C. 553.

4. Accordingly, IT IS ORDERED, pursuant to Sections 4(i), 5(d) and 303 of the Communications Act of 1934, as amended and Section 0.231(d) of the Commission's Rules and Regulations, that effective April 16, 1974, Section 97.61 of the Commission's Rules is amended as set forth in the attached Appendix.

Frequency band	Emissions	Limitations
kHz		
1800-2000	A1, A3	1, 2
3500-4000	A1	
3500-3775	F1	
3775-3890	A5, F5	
3775-4000	A3, F3	4
7000-7300	A1	3, 4
7000-7150	F1	3, 4
7075-7100	A3, F3	11
7150-7225	A5, F5	3, 4
7150-7300	A3, F3	3, 4
14000-14350	A1	
14000-14200	F1	
14200-14275	A5, F5	
14200-14350	A3, F3	
MHz		
21.000-21.450	A1	
21.000-21.250	F1	
21.250-21.350	A5, F5	
21.250-21.450	A3, F3	
28.000-29.700	A1	
28.000-28.500	F1	
28.500-29.700	A3, F3, A5, F5	
50.0-54.0	A1	
50.1-54.0	A2, A3, A4, A5, F1, F3, F5	
51.0-54.0	A9	
144-148	A1	
144.1-148.0	A9, A2, A3, A4, A5, F9, F1, F2, F3, F5	
220-255	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5	5, 6
420-450	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5	5, 7
1215-1300	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5	5
2300-2450	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5, P	5, 8
3300-3500	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5, P	5, 12
5650-5925	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5, P	5, 9
GHZ		
10.000-10.500	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5	5
24.000-24.250	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5, P	5, 10
48.000-50.000	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5, P	
71.000-84.000	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5, P	
152.00-170.00	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5, P	
200.00-220.00	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5, P	
240.00-250.00	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5, P	
Above 275.00	A9, A1, A2, A3, A4, A5, F9, F1, F2, F3, F4, F5, P	

LETTERS

ou goons don't ever proofr
lousy
bunch of rocks
you ignored my comments in
I insist that you print ev

Dear Counsel:

In a recent column, you said tax rebels are "thoroughly convinced" that the federal income tax is unconstitutional. Is there any basis for this conviction?

Yes. Perhaps the strongest support is found in an article published in the December, 1972 issue of the American Bar Association Journal. It forcefully indicates that the present internal revenue code is so discriminatory as to violate the uniformity principles of the U.S. constitution.

I urge you to read this article. It was written by a top-rated lawyer, William G. Halby, formerly the tax partner in a very substantial law firm, now with Equitable Life in New York City. His analysis merits careful study by every American.

The 16th amendment to the constitution permitted congress to tax "incomes, from whatever source derived," without apportionment among the states. Still, any income tax law must be uniform, and must not deprive people of their property without due process.

The present federal income tax was enacted in 1913. In 1916, the U.S. Supreme Court held that it did not violate the uniformity and due process requirements of the constitution. But the present code bears little resemblance to the 1913 law, and judicial views have changed a lot in the last 58 years.

By implication, the Pennsylvania Supreme Court in 1971 said the present federal income tax is unconstitutional. The state had enacted an income tax law that adopted federal "taxalbe income" as its standard. Federal taxable income is the figure a taxpayer arrives at after taking exemptions, credits, deductions and other preferences to which he's entitiled. It's line 48 of the 1973 form 1040 return.

This Pennsylvania law was challenged quickly. In a 1971 decision, *Tilghman v. Kane,* the Pennsylvania Supreme Court held that it violated the uniformity clause of the Pennsylvania constitution. Why? Because it used "federal taxable income" as its standard.

The court found that Pennsylvania, by adopting this federal standard, created widespread tax preferences. Taxpayers with the same amounts of income were required to pay different amounts of taxes, depending on whether they were wage earners, investors, home owners, tenants, or something else. Result: "Unequal burdens" were imposed "in violation of the uniformity clause" of the Pennsylvania constitution.

So what? Does the Pennsylvania uniformity clause mean the same thing as the uniformity provision of the federal constitution? The Pennsylvania Supreme Court said "yes" in *Pennsylvania v. Girard Life Insurance Company,* a 1932 decision.

In this case, the court found that the Pennsylvania uniformity clause, as applied to tax matters, was parallel in meaning with the equal protection and due process clauses of the federal constitution. What would violate one generally would violate the other, the court said.

So, if the Pennsylvania Supreme Court were to pass on the federal income tax today, in all probability it would find the law unconstitutional. And if the question were squarely presented, the U.S. Supreme Court easily could reach the same conclusion.

Unfortunately, congress and treasury officials have muffed the Tilghman message, just as they have turned deaf ears to other solemn warnings of a coast-to-coast taxpayers' revolt. Time is running out. Let's shelve Watergate and get on with fundamental tax reform, before it's too late to head off impending disaster.

E. Edward Stephens
815 King St. 3rd Floor
Alexandria VA 22314
(703) 683-3900

WHY I HATE WAYNE GREEN

1. I suppose I hate Wayne Green mostly because he *thinks.* He thinks that a QSO should consist of more than just an exchange of signal reports, names, QTH's and type of equipment. He thinks that amateurs should do more than just try to see how many countries, counties, states, or whatever, they can work. He thinks that amateur radio is more than just a hobby, and that an amateur license imposes special responsibilities such as public service, making contributions to the advancement of the state-of-the-art, and spreading international goodwill.

2. I hate Wayne Green because he thinks that, even in these days of Watergate, there should be a sense of morality in our government. After all, what is so wrong for the FCC to take away 2MHz of the amateur 220 band just so the EIA can sell more radio equipment?

3. I hate Wayne Green because he refuses to be humbled by the dictates of the State. He thinks that since the government is supposed to be "of the people, for the people, and by the people," and since the IRS is a branch of that government, that "we the people" should be their bosses.

4. I hate Wayne Green because he is constantly needling the ARRL to become more activist. He should realize that due to the many League accomplishments over the past 50 years, the League should now be allowed to rest on its traditions and laurels.

5. I hate Wayne Green because he wants his readers to write his publication for him. He constantly asks in his columns for contributions of articles. He should realize that then any idiot could write an article for his publication. Too much readership participation is a dangerous thing!

6. I hate Wayne Green because of his interest in VHF. He thinks that just because the entire history of radio is one of moving to constantly higher frequencies, amateurs should follow that trend.

7. I hate Wayne Green because of his interests in other fields besides amateur radio. Kirlian photography, science fiction, and IRS troubles have nothing to do with my hobby! When I open an amateur publication, I want to shut out the world around me.

8. I hate Wayne Green because he sometimes disagrees with some of the regulations proposed and adopted by the FCC. He should realize that the FCC and its Amateur and Citizens Division always knows what is best for our hobby.

9. I hate Wayne Green because he is controversial. He should know that there is never any controversy in amateur radio. It should always be hushed up or committeed to death.

10. I hate Wayne Green because the prize for winning this crazy contest is a trip to the Bermuda Triangle! If you all don't mind, I'd prefer to travel to someplace a bit safer, like Vietnam, Cambodia, or the Middle East!

Phil Sager WB4FDT
3827 N. Abingdon
Arlington VA 22207

EDITORIALS HELP?

Wayne, I hope your editorials in 73 create enough activity by the taxpayers to force the IRS to change its policies.

Name Withheld
Toronto OH

SOLID STATE NEWS

In a recent editorial Wayne asked if there was anyone out there in Hamdon who would like to write a solid state column for us. The result: We were inundated with sample columns. Our minds were boggled and we couldn't reach a decision on which column to run. So we've decided to let you make the decision for us. Here are two columns. Next month we'll run more. Write and tell us which column you liked the best. We'll tally up the results and use the column that gets the best reader response.

Waller M. Scott K8DIZ

Through this new column we will try to keep you informed of new developments in the fast moving field of solid state electronics, with ham type applications in mind. As new products become available the ones of greatest interest to hams will be described along with suggested applications. We hope to give hints as to where the products can be obtained and for how much.

New ICs for receivers continue to pop up. Fairchild's μA720, primarily intended for AM car radios, can be put to many different uses at frequencies up to 30MHz. This device contains an rf stage, oscillator, mixer, i-f amp, AGC circuit and voltage regulator. The detector is not included in the IC so you are free to choose either a simple diode detector, product detector, or even add additional i-f or mixer circuits. RCA has introduced its CA3123 which is an identical IC. Sprague has their ULX-2137, National, the LM1820 and Motorola plans to announce an equivalent later this year. With all these sources, availability for the ham receiver-builder should be quite good. Mention should also be made of the RCA CA3088 receiver IC. It also is useful up to 30MHz and performs well as a receiver without an rf stage. The 3088 contains built-in i-f AGC and has an AGC amplifier for use with an outboard rf stage. An excellent choice for the rf would be a dual-gate FET using the 3088 AGC for gate No. 2. Additional features of the CA3088 include a built-in 30dB gain audio pre-amp and a drive circuit for an S-meter. The distributor prices of all these radio receiver ICs range from $2 to $3, but some of 73's advertisers may give you a better deal.

Quad op amps are very useful building blocks for an endless variety of circuits including audio, control, oscillators, voltage regulators, active filters, sweep generators, etc. Of course, all these can be built with single op amps too, but the convenience of having four amps on one chip makes circuit layouts smaller and more versatile. An added bonus is closely matched operating and temperature parameters since all of the op amps are processed under identical conditions. Texas Instruments' new SN72L044 is the first quad op amp designed for low power operation. When powered from a ±2V supply, it consumes only 340 microwatts! A natural for battery powered or portable equipment. All four amplifiers draw a total of 0.25 mA at ±15V supply voltage. This is idle current. Of course, your circuit design will determine how much load current will be added to the idle current. These low noise amplifiers are grouped into two sections so that power can be applied to only two of the op amps, if desired, further conserving power. Other features include internal frequency compensation, high slew rate, and output short circuit protection. For applications requiring only two low power op amps, TI also makes a dual device, the SN72L022. The quad is offered in a 16-pin DIP and the dual in both 8-pin DIP and metal packages.

If your interest is in ultra low power op amps, Siliconix has the L144 tripple. The three op amps draw only 150 microwatts (50 each) when operated from ±1.5V. This device features supply voltage to ±15V, internal compensation, programmable bias current, programmable power dissipation, single programming resistor and 80dB gain.

Single supply voltage op amp quads have been around for over a year. There have been some new additions, however. These devices have become unusually popular with the electronics industry, especially with the auto manufacturers. The performance, versatility and low cost make these ICs a must for anyone interested in experimenting with solid state circuits. The National LM3900 and new LM2900 have an open loop gain of 2800, unity gain BW of 2.5MHz, and operate over the voltage range of +4 to +35V. The Motorola MC3301 has a gain of 2000, BW of 4MHz, range of +4 to +28V. The Motorola MC3401 and new RCA CA3401 have a gain of 2000, BW of 5MHz, and a range of +5 to +18V. All these ICs have internal frequency compensation, require low input bias currents, and have output short circuit protection making them easy devices to use. Distributor prices for all these devices are just over $1, although some suppliers are selling them for 50¢. One of the best application notes ever written is available for the LM3900 from National Semiconductor (AN-72). It applies, in principle, to all the other types mentioned.

Timer circuits are finding their way into many ham designs these days: repeater timers, electronic keyers, delay circuits, and station ID timers to name a few. National Semiconductor has a couple of new precision timers, the LM3905 and LM322. Both of these timers operate over the wide range of +4.5 to +40V and maintain constant timing periods from milliseconds to hours. The LM322 provides excellent repeatability down to 3 microseconds. A minimum of outboard components are required. An RC network sets the timing, which is begun by the leading edge of an externally generated trigger signal. The timer output is a floating transistor with current limiting and can drive either ground or supply referred loads up to 40V at 50mA. You can program the output transistor to be either off or on during the timing period. The LM322 has two additional features not in the LM3905. One is the accurate short interval timing already mentioned. The other is an input to allow a 50:1 ratio adjustment in the timing cycle with a given RC by varying a voltage applied to that terminal. This feature allows use of the IC as a switching regulator, voltage comparator, or voltage to pulse rate converter. The low input current requirement allows use of a smaller timing capacitor for long time-outs, lessening the need for precision low leakage capacitors. These timers are available in several environmental temperature ranges. The LM322 is in a 14-pin DIP and the LM3905, an 8-pin DIP.

While talking of timers, we should mention the new Exar XR-2340CP programmable timer-counter. This IC is capable of producing ultra long time delays without sacrificing accuracy. Programmable time delays from microseconds to five days are available. Two ICs in cascade can generate time delays up to 3 years! Other applications of this IC include operation with an external clock, use as a frequency synthesizer (programmable), a staircase generator, 8-bit analog to digital converter, etc. The IC consists of an RC controlled time base, a binary counter (8-bit), and a control circuit. The basic time unit is set by choice of the RC network. The binary counter counts each output pulse from the time base. The desired time-out is selected by appropriate connections to the counter output pins. The timing cycle is programmed to be between 1T and 255T where T=RC. Accuracy of 0.5% and excellent temperature stability are claimed. In quantities of 1 – 24 the price is $4.50.

If you do not know of a local distributor who sells the devices mentioned, a letter to the appropriate manufacturer should get you a list of distributors and possibly data sheets and application info on the circuit of interest. 73 advertisers who specialize in solid state components can possibly supply you parts even though they are not currently advertised.

Addresses of manufacturers mentioned this month are: Fairchild Semiconductor, 464 Ellis Street, Mt. View CA 94043; RCA, Solid State Division, Box 3200, Somerville NJ 08876; Sprague Electric, Semiconductor Div., 115 N.E. Cutoff, Worcester MA 01606; Motorola Semiconductor, Box 20912, Phoenix AZ 85036; Texas Instruments, Box 5012, Dallas TX 75222; Siliconix, 2201 Laurelwood, Santa Clara CA 95054; National Semiconductors, 2900 Semiconductor Drive, Santa Clara CA 95051; Exar Integrated Systems, 750 Palomar, Sunnyvale CA 94086.

We would be pleased to hear from you as to what type of solid state developments you want to hear about in this column. **K8DIZ**

Vern Weiss II WA9VLK

I would like to invite you to become a part of this column. If you have a technical problem, jot it down and mail it to me. If you have a recent solid-state success in your life and you're busting at the seams to tell someone about it, write! Even if you have run across a newsy vacuum tube gadget, don't keep it from the masses. While the emphasis of this column is on the ham radio applications of solid state electronics, I have always felt that a well rounded ham shack is a hybrid ham shack. When pulling ourselves away from our own established prejudices we must admit that many electronic applications perform better with transistors while others simply lend themselves better to the good old valve parameters.

A LITTLE BLAH THEORY

If you are an average ham you probably feel that transistors are cute, nifty and wowee-Mama-watch-this. You also probably have a good knowledge of electron tube theory, but for now prefer to satisfy your solid state knowledge void by buying a Heathkit and worrying about theory later. Therefore, we are going to give you a shot of theory each month — in small doses - to ease the pain.

Tubes and transistors perform many of the same jobs, but in construction are entirely dissimilar. The first and most obvious difference is that they do not look alike. Tubes and transistors are made of different recipes. Nowadays, transistors are made of silicon-crystal or germanium metal materials. Most transistors presently used are of the silicon type. To complicate things even more, there is some experimentation taking place with semiconductor production involving the combination of the two elements, silicon and germanium. But for the most part, Germaine and Si have the market cornered.

Tubes as you will recall (get out the license manuals) are voltage-operated devices while transistors are current operated. Ah-Hah! You've got me there, right? I wince at the thought of you sitting there prepared to hit me with, "OK stupid, how do you explain the presence of current in tubes and voltage in transistors?" H-m-m-m. Let me think a minute. For now, let's just say that in a tube you can have the presence of voltage but not of current. Alternately, in a transistor, there can be current present but no voltage. Therefore, the tube must get its minimum daily requirement of volts if it is going to exist and live a happy life producing many, many happy little milliamps. In transistors the whole process is reversed. To further illustrate; how many times have you been trouble-shooting that final amplifier and was baffled because the 6146 had voltage but no plate current? This gets into specific conditions which will be dealt with later.

Often transistors, which thrive only because of the current within, are wrongly compared to tubes. The comparisons and "interchangeability" stem from nothing more than ever anxious marketing techniques and sales pitches and has little basis. The only parallel that should be drawn is that tubes and transistors can be harnessed to perform similar results in a circuit.

To dissect the "guts" we see that a tube (with its ohhh so warm glow on a cold New England night) grid controls the electron flow between the cathode and plate. Likewise, a transistor (with its cold, silent. . .almost standoffish personality) base controls the current flow between the emitter and collector. We also see that in a tube, the cathode shoots them thar little electrons off to the plate, which in turn, sucks 'em up. In the transistor, the emitter (so named because of its station in life) shoots the electrons over to the collector which catches them, like a solid-state Yogi Berra.

A mnemonic device to help remember these two component's inner-operations in relation to each other might be: Cathode — cathode; Grid — glow; Plate — proudly; Emitter — Emitter; Base — be; Collector — cool; . . .oh well.

THE DYNASCAN B&K 162 TRANSISTOR/FET TESTER

Those seeking an excellent transistor tester should seriously consider the B&K 162 TRANSISTOR/FET TESTER. The unit is accurate, fairly inexpensive, attractive and I consider it one of the better pieces of electronic test equipment available.

The unit displays a complete analysis of all bipolar transistors, field effect transistors, diodes, unijunctions, SCR's and triacs, whether tested in the circuit or out.

Since a transistor tester capable of monitoring every transistor component condition would be well beyond the financial grasp of many, the B&K does a nice job of diagnosing a component's state of being from a few universal tests which are sufficient to determine good-bad and current gain. A sequential switching procedure is involved in checking all solid state devices, therefore, no time consuming or confusing tester set up is required. With two rotatable switches (that 'click' so solidly) one can perform three leakage tests and a beta test. FETs may be tested with their own one-switch-to-test steps, measuring conductance (Gm), gate control and leakage. Even beginners would have no problem with operating the 162, and they probably would pick up a basic understanding of what solid state is all about. The instruction pamphlet is a storehouse of information in itself.

The B&K 162 has a METER! I mean. . .a *real* meter! It's a large, clear, easily read and highly responsive indicator and ohhh, what fine precision meter movement.

The only drawback is that the 162 is run on flashlight (D) batteries. This factor, coupled with its lightweight, makes it super-dooper for field service, but I have always preferred good 'ol 110 when it comes to test equipment. There's really no worry about inaccurate tests due to failing batteries as the B&K people built in a nifty battery test circuit, so I guess I have no real cause to gripe. Those with big fingers might do well to practice clamping the small test leads onto small component leads in small areas. It takes some diligent finger-gymnastics and a lotta hope to get the leads clipped onto the device under test in today's jam-packed circuit boards.

The B&K is a professional piece of gear through and through and any ham who has one is ready for serious solid state construction and repairs. The tester is one of those electronic devices you naturally want to put back into its box after each use. Cost is the same as 200 packs of cigarettes. . .and well worth every pack.

It looks as though space is running out, but again I want to emphasize that I would like to hear about those projects of yours. . .and problems. The idea of awarding a handsome award each month for THE homebrew project has been proposed, so get out the junk box and set out to dazzle and amaze us. Next month I have a handy little transistor aircraft band receiver for those of you frequently in the "hanger-flying" situation, desiring something on VHF that works from the innards of a Band-Aid box.

See you on the circuit!

WA9VLK

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4-1000A GROUNDED GRID LINEAR

Featuring:

Solid state alc
Shielded module construction
Plate vacuum tuning
80 through 10 meters
Thyrector protection
4-1000 technical summary

Simplified module construction incorporated with up-to-date features including high plate dissipation make this linear amplifier an excellent choice for reliable contest, rag chewing or SSTV applications.

Construction

The following tools were used in the construction of the amplifier: metal munching tool, pop rivet gun, electric drill, various hand tools and a good soldering gun.

The main chassis 43.18 x 43.18 x 10.16cm (standard) and the front and back of the amplifier is constructed from 43.18 x 43.18 x 7.62cm (standard) and 33.02 x 17.78 x 7.62cm (standard) chassis respectively. The front and back are mounted to the main chassis by pop rivets around the perimeter. The cover is manufactured by hand bending a 48.26 x 121.92 x .16cm (standard) sheet of aluminum to tightly fit chassis assembly and is held in place by sheet metal screws at 3cm intervals.

Bending can be accomplished with two pieces of angle iron. The material to be bent is clamped between the angle irons using C-clamps and a vise. Use a piece of flat wood as a protector between the hammer and the material to be bent to avoid unsightly hammer marks. A commercial metal bending brake will no doubt do a better job in far less time provided you have or can borrow one.

The air is exhausted by mounting home air vent assemblies on the sides of the cover and perforated aluminum sheeting over holes on the top and back. A total of six holes are covered by the perforated aluminum.

To achieve proper shielding, the screen in the air vent is removed and replaced with perforated aluminum eave trough screen, available at most hardware stores. When properly installed it provides excellent shielding but it is too weak to be installed without a frame. Attach the air vents a minimum of every 2 cm around the perimeter of your cover to provide adequate shielding. Small aluminum pop rivets really come in handy here but make sure each rivet is fitted tightly. Before I attached aluminum to aluminum I roughed each contact surface with extra fine sand paper to assure a good electrical connection. Also, each chassis was electrically connected together by lengths of copper braid.

The front of the amplifier contains a relative output meter (lower left), plate current meter (upper right) and grid current meter (upper left). The high voltage reading

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was taken from a voltmeter mounted directly in the power supply.

The three controls on the front in the lower left are cathode tuning, relative output level and alc level. Also included is a turns counter in the upper right for the vacuum variable capacitor and a vernier dial for the loading capacitor. The band switch is located in the middle and ganged to the cathode circuit via two right angle drives, providing single switch band switching. Once drives were properly adjusted I soldered them to the shaft to prevent slipping.

The bottom plate is made from .32cm (standard) aluminum or steel with one caster at each corner. It should be held in place by sheet metal screws placed a distance of 3 cm to insure adequate shielding.

To provide safety and stability, many sub-chassis are used. The alc and relative output circuit are shielded in the final enclosure. The sub-chassis are relatively inexpensive if purchased, but could also be hand formed.

The alc and relative output circuits are enclosed in aluminum miniboxes. The plate and grid current meters are enclosed in a 12.7 x 25.4 x 7.62cm (standard) chassis with steel or aluminum bottom plate attached. The relative output meter was a shielded meter and provided low measured leakage with no enclosure. The loading capacitor has an added frame enclosure but it is not critical in the design. The rear of the amplifier is designed with safety in mind. The B+ and B– connections are in a 12.7 x 10.16 x 7.62cm (standard) chassis with two grometted holes in the bottom. High voltage cables should have a minimum rating of two to three times the voltage expected to be encountered. The blower is fused and the blower solder connections and fuses are located in a small minibox. The ac line is terminated in a small sub-chassis and at this point the thyrector attenuates line transits providing protection to your solid state devices. The ac is fed into the bottom chassis through two feedthrough capacitors and is fused in the plug with two fuses, one on each side of the line. This places all but one fuse externally and readily available. Located on the back are three shielded banana outlets for vox, alc and the high voltage

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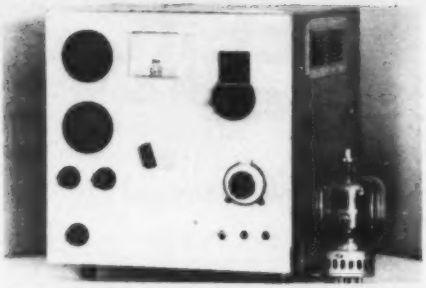


Front view. Meter upper left grid drive, lower left relative output, center plate current. Three controls in lower left. Alc far left, relative output sensitivity right, cathode tuning lower left. Front center control band switch. Upper right turns counter. Lower right loading control. Switch, on and off. Green filament light left. Red high voltage light right. Note: air vents on side.

light. Located below the banana plugs is a heavy-duty ground connector *which should be utilized to recude possibilities of electrical shock.* The rf is fed directly into the lower compartment and output is taken directly from the upper chassis to eliminate the problem of feedback. Shielding between input and output circuits of a grounded grid amplifier reduces the possibility of parasitic oscillations. The large opening in the rear of the amplifier where air enters the pressurized bottom chassis from the blower must be adequately shielded. An aluminum screen mounted over the hole and bolted in place at a minimum of every 2 cm insures good electrical connection between the screen and chassis. Be sure to clean the screen occasionally as it will clog up with dust, decreasing air volume. Place the blower a good distance away from the tube socket and seal any undesirable air leakage points in the bottom chassis with silicone rubber sealer to provide a good pressurized system. Cutting the lower flange off the tube socket will also provide better unrestricted air flow if you use the standard SK-510 socket.

To protect the operator, metal shafts that protruded out the front were equipped with insulated shaft couplings. All shafts at ground potential were connected directly to ground via flexible copper cable. This was done as double protection even when the shafts were already at ground potential, as in the case of the loading capacitor. I took great care in these connections to guarantee they were electrically and mechanically strong.

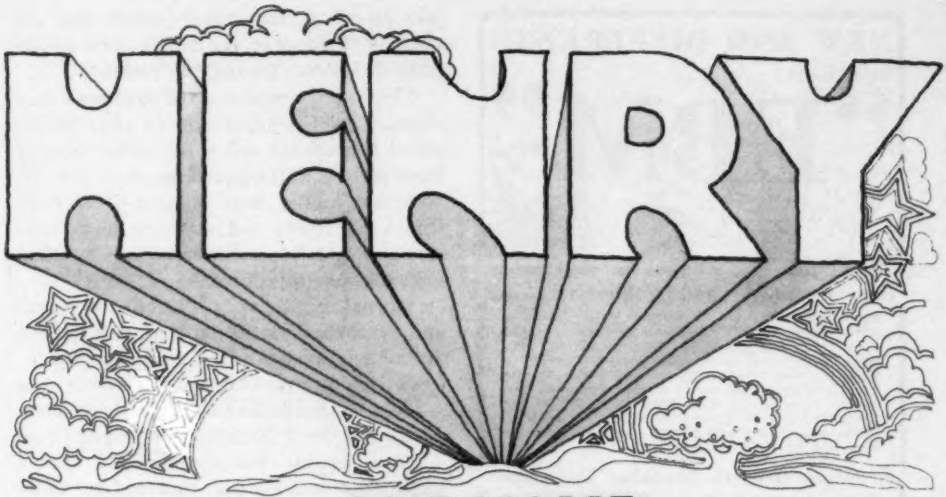
Wiring

The wiring of the amplifier is straightforward. If you are contemplating construction and have not built a linear before, I would recommend the reading of construction techniques, as applied to rf amplifiers, in the handbooks – particularly the section on preventing radiation from the transmitter.

The input circuit is a tuned cathode circuit. The 4-1000 requires a substantial amount of drive; therefore a cathode tuned circuit is a must. This reduces drive requirements and also provides improved distortion products. When constructing this circuit, keep in mind that 10 meters may be a problem in respect to drive – therefore align coil and capacitor combination to provide short connecting leads on ten. Silver plating the cathode coil and leads also provides measurable improvement on ten. I had no problem with drive, but if your exciter is marginal it could make the difference.

Grid drive is monitored with a 0-1 mA meter utilized as a millivolt meter. *Be sure to calibrate meter before soldering the screen.* As the screen is operated in parallel with the control grid it must be disconnected from ground so that you are reading control grid current only. To calibrate the meter you must determine the proper value of the series resistor Rx. This is found by placing a regular milliammeter with a scale of 200 mA or more from the vox terminal to ground. Carefully apply excitation with no plate voltage and substitute resistors at Rx until both meters have the same deflection at 100 mA. My meter required 82Ω but this is variable depending on meter characteristics. Another meter may require a larger or smaller value. As the 4-1000 has no plate voltage at this time, the control grid dissipation can be easily exceeded. Therefore be extremely careful and work quickly during periods of excitation.

The plate current is measured by the meter being shunted across a 10Ω resistor in the negative high voltage lead. The resistor



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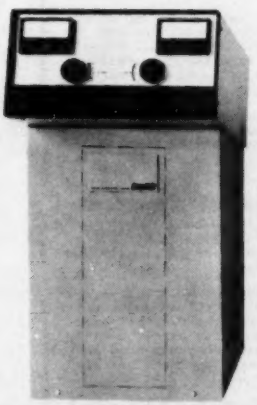

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Just by way of example, the section on hand soldering was boiled-down from the practices of the American Welding Society -- Committee on Soldering and Brazing; NASA, USN, solder manufacturers, the Bell Telephone System and others. The section contains everything you need to know about solder, fluxes, soldering tools and techniques.

There are over 100,000 words covering theory and application of semiconductor devices -- diodes, transistors, the SCR/TRIAC, digital and linear integrated circuits, operational amplifiers, voltage regulators, counters and decoders, and much, much more.

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was placed at the power supply and the negative terminal of the supply must not be grounded except through the resistor.

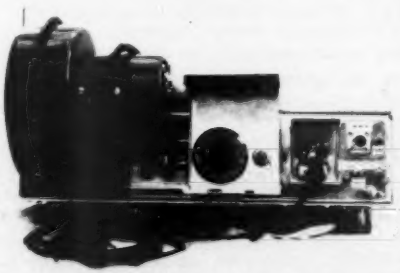
The screens are connected to ground via a .64cm flexible copper ground strap which passes through the slot of the socket directly from ground to the screen pin. Both pins are grounded in the same manner. Keep leads short! All power and metering leads were shielded and bypassed according to good construction procedures.

The entire plate circuitry was silver plated and the connecting output lead from the coil assembly was of silver plated .65 cm (standard) copper tubing. The plate and vacuum capacitor lead are made from silver plated flexible 1.27cm copper ground strap.

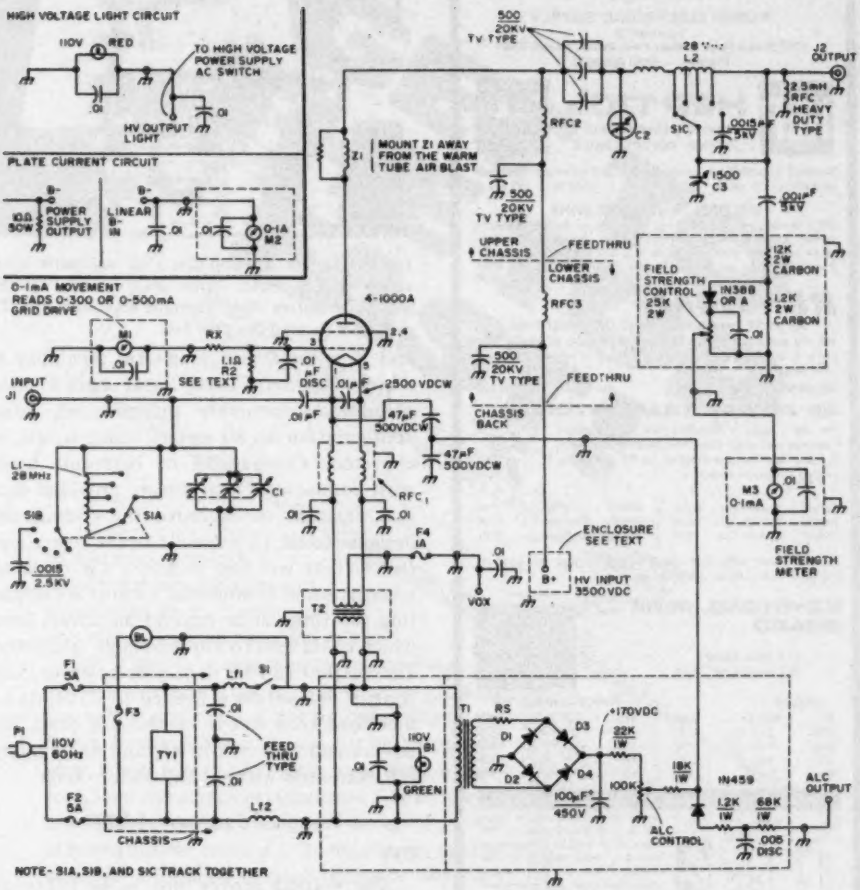
Silver plating was accomplished with a small electroplating unit powered by flashlight batteries. It was simple and required no special skill. There are different units available from various electronic outlets with prices starting at a few dollars.

Adjustment

Before applying any potentials recheck all wiring. Set the sensitivity of the output indicator to minimum, that is, maximum resistance with the slider of the 25K pot at ground. Connect a dummy load of 52 to 72Ω. Select the proper band with S1 and apply plate voltage. Apply a small amount of excitation. Peak up C1 for maximum reading. Resonate the output circuit with C3, making sure the loading capacitor is set at full capacity. Adjust C3 and C2 to increase



Right to left: Rear view showing ground, alc, H.V. indicator, vox terminals, rf input terminal, ac input showing feed-through capacitor, thyrector and enclosure. Middle enclosure B– and B+ terminals. Left enclosure blower ac supply and fuse. Far left blower.



Schematic diagram of the modern 4-1000A, Class B, grounded grid, linear amplifier.

the plate current to the input power level you desire while increasing drive to 120 to 150 mA. You will probably note that the rf output meter and plate current meter conflict somewhat. Maximum output does not always occur at the point of resonance. Don't let this alarm you, adjust your drive and loading to a point where for a given drive, the output drops off slightly at your desired input. This is the point where you will generally achieve the best linearity. Once you have established your tuning for a band, record turns and loading for future reference.

To utilize the alc properly, connect the exciter to the linear via the alc connector on the rear of the amplifier. Once connected you may adjust your alc to achieve the maximum limitations you desire. The alc section, if properly utilized, can increase the average power output while maintaining the linear within the amateur power-input limit, providing that extra punch to communicate under adverse conditions.

Operation

The operation of the amplifier has been excellent. It provides adequate efficiency

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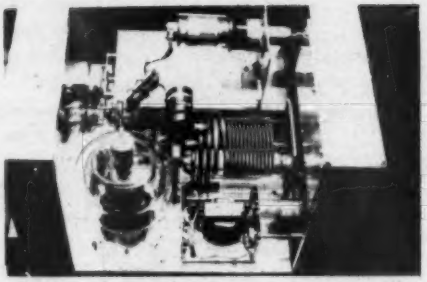

Looking down on amplifier's alc enclosure cover removed for photo. Note: also vacuum variable mount. Relative field strength enclosure and 2.5 mH rfc is located in upper left.

and it is built with long-term reliability in mind. The multi-band linear circuit compared most favorably with a single band configuration on 80 meters which would be expected. Comparison of harmonic levels with commercial ham linears provided data that equalled or exceeded the commercial designs tested. In respect to tube operation, the 4-1000 will loaf at the 1 kW dc level, whereas some commercial circuits are operating the finals at or beyond maximum level which could lead to unpredictable reliability. The 4-1000 can be damaged, however. The control dissipation is limited to 25 watts — therefore keep an eye on the grid drive. Do not exceed 200 mA drive, and *never* apply full excitation without any plate voltage.

Technical Summary 4-1000A

TVI

The 4-1000 proved not to be guilty of rampant TVI. The circuit described was compared with commercial amplifiers at the same power level, 1 kW, dc, and it provided equal or better results. Circuits designed, constructed and operated according to good engineering practice should provide excellent results. Persons experiencing severe TVI problems with the 4-1000 should review their design and operating parameters for possible errors. This is not to discount problems due to rectification or overload. However, these problems are not the fault of the linear.

Drive requirements

The 4-1000 does require a fair amount of drive. Most commercial exciters should drive

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the amplifier to 1 kW dc up to 15 meters, however.

Ten meter drive requirements may be a problem for two basic reasons: (1) Some exicters fair poorly when it comes to output on 10. They provide substantially less output on 10 as compared with 15 meters. A check of your exciter's output efficiency would be advised before selection of this tube for 10 meters. (2) When building the multi-band input cathode circuit, much energy can be lost in this configuration. Normally the majority of loss is at the highest frequency of operation.

Parasitic oscillations

If the 4-1000 circuit is wired according to good engineering practice with proper preventive measures taken, you should have no unusual problem with parasitics. Before you place your amplifier on the air, you should completely check it for parasitics on all bands. When first constructed, a parasitic may well occur but once the amplifier has been stabilized, it should provide excellent results. Parasitics are generally the result of the layout and wiring and not the tube per se. Keep in mind that it is indeed a lucky ham who builds a linear with any type tube who has a completely stable amplifier to begin with.

Negative aspects

Tube cost is considerable. Although I used new tubes in my circuits, used or pull-out tubes have in some cases been used to advantage. But beware, a pull-out tube may have very low emission, causing a change in plate load impedance requiring changes in loading parameters for maximum efficiency.

The air flow required causes irritating noise. Even if a low noise blower is used, air whistles as it flows through the perforated holes in the shielding. If you are using a great amount of audio processing the noise level may be prohibitive.

The tube is large physically, which requires a large enclosure.

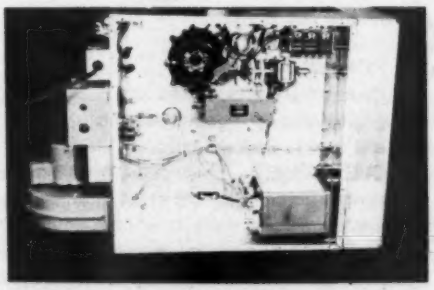
Component Modifications

To prevent the possibility of high voltage breakdown due to moisture at the base of the B&W 800 a fiber screw replaced the metal one supplied. Also, the B&W 800 was not mounted directly on the chassis. A 2.54 x 5.08 x .32cm (standard) piece of plexiglass was cut and the choke was mounted to it. The plexiglass was mounted 1.27cm above the chassis on two 1.27cm insulated standoffs.

An extra switch position is required for the B&W 850A so that the .0015 μF mica capacitor can be switched in on 80 meters. An extra contact for constructing the switch is available from Barker & Williamson in Bristol, Pennsylvania.

A note on the B&W 850A

The B&W 850A multi-band inductance does an adequate job of impedance transformation considering it covers 80 through 10 meters. It does not, however, provide the optimum results that a well-designed single band linear can provide.



Bottom wiring view.

In essence, if you are a band hopper and prefer convenience, the B&W 850A will fill the bill. But if you are basically a one-band man, critical about efficiency, you would probably be happier omitting the B&W 850A, saving a few bucks and going single band by replacing L2 with a single band inductance. For further details see pi-network design in the various handbooks and journals.

Credits

I would like to thank the countless amateurs who generously gave their time and advice, which helped in the design, construction and testing of this circuit.

...K8VIR

Kent A. Mitchell W3WTO
1004 Mulberry Avenue
Hagerstown MD 21740

FREE TT BATTERIES

By now, most everyone is aware of the new Polaroid SX-70 color camera. If you don't have one yet, you probably have a friend that does, and in any event you consequently know that the camera system contains sophisticated IC circuits (containing more than 200 transistors) which provide automatic exposure settings, an electronic shutter, flashbulb sequencing and firing circuits, and a special high speed motor to expel the exposed photograph from the camera

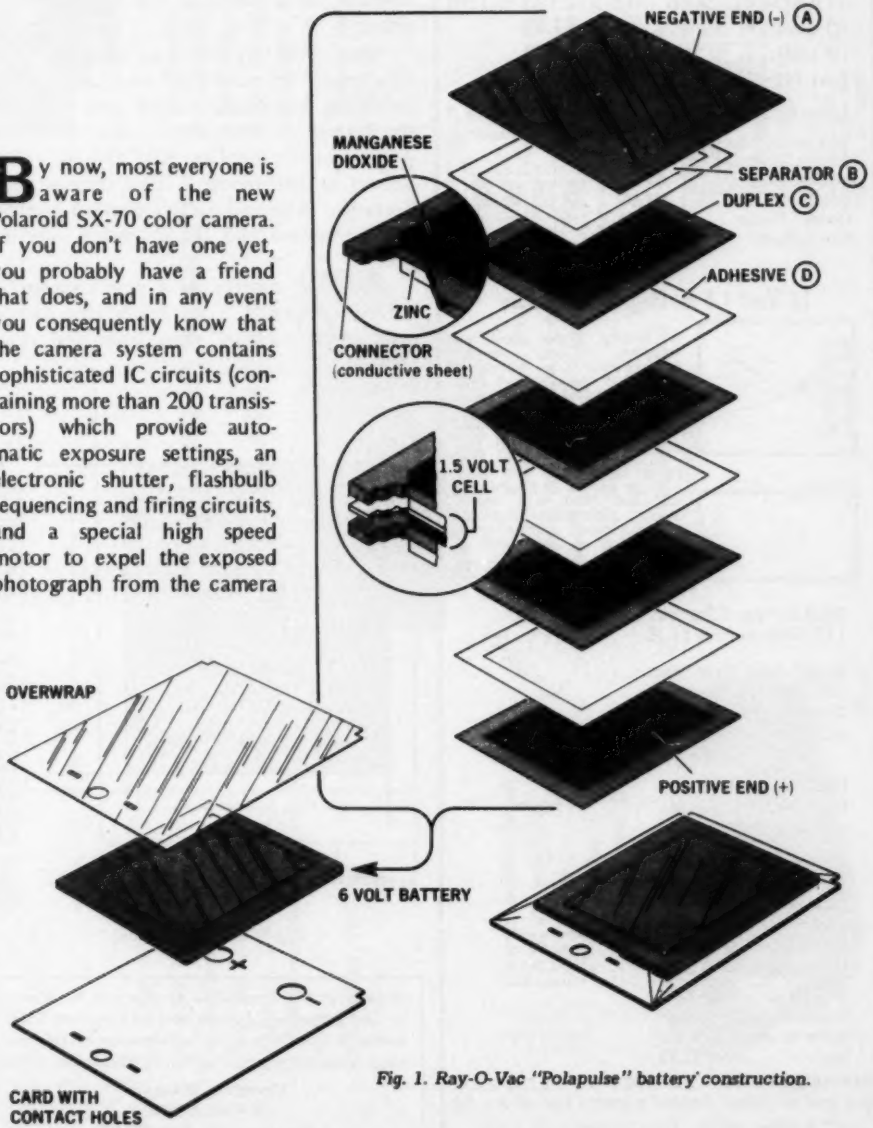


Fig. 1. Ray-O-Vac "Polapulse" battery construction.

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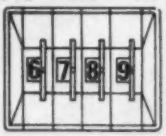

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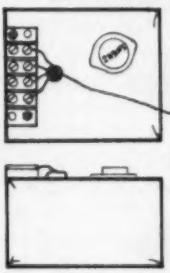

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body. To insure adequate power to perform all of these functions, the Polaroid people took no chances and built an internal battery into each film pack. This means that after only a few seconds use an almost new power source is disposed of! This is more than my frugal "don't throw it away. . .it may be good for something" glands could tolerate, as a glance at my junk box will prove.

After collecting several of these discarded film packs my curiosity was satisfied by dissecting the plastic holder and removing the battery. . . whereupon I discovered that it was manufactured by RAY-O-VAC and is known as their model P-70. A note to their Technical Sales and Service Section brought quick response and the following information.

The P-70 battery is a new concept in battery packaging. Four 1.5 V zinc carbon cells in a 3.2 mm thin laminated stack

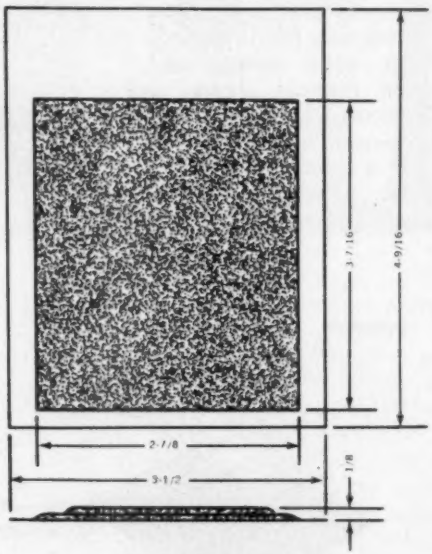

Fig. 2. P-70 dimensions.

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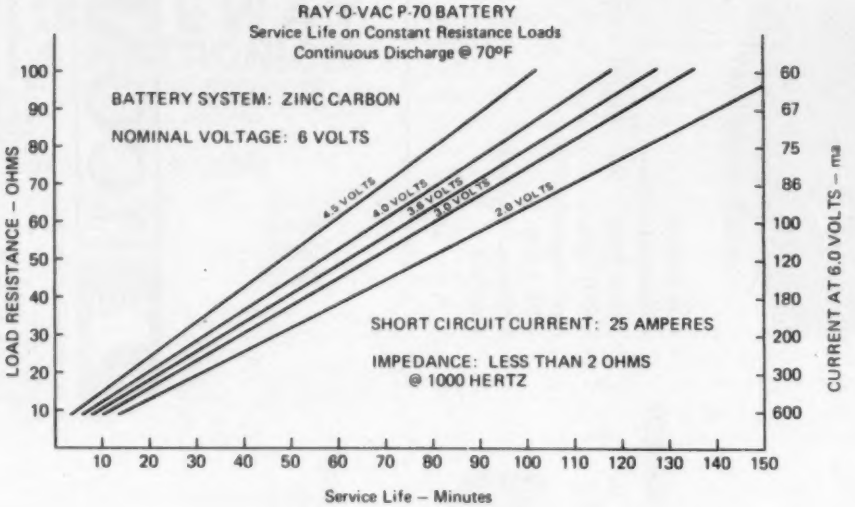

Fig. 3. New battery performance.

produce a 6V battery that is protected by steel and mounted on a card for easy handling. This type of construction provides a large electrode surface area capable of producing high current with a small battery volume. Each individual cell is composed of a top sheet (A) of steel coated with zinc on its underside, a separator (B) and a conductive sheet (C) coated on the top side with manganese dioxide and coated on the bottom with zinc, see Fig. 1. The individual cells are electrically connected by the conductive sheet. When the cells are stacked, an adhesive perimeter (D) on each separator fastens the cells together. The steel top sheet wraps around to the bottom of the stack to permit the minus and positive terminals to be on at the same side. The pack is mounted on a cardboard sheet, insulated and sealed with a clear plastic film overwrap. The overall dimensions are shown in Fig. 2.

What we have to work with is a small, thin, flexible battery capable of producing high current rates for short durations. An application for these batteries which immediately comes to mind is power for touch tone pads. Most pads are designed to operate from 9 to 15V, so two of the P-70 batteries in series would do the trick. A standard Western Electric pad draws about 12 mA when producing a tone. The power output capabilities for a new battery are shown in Fig. 3. I ran a series of tests with a used pack under a continuous 200 ohm resistive load, while monitoring current and voltage, and observed a nominal 5.8V at 26 mA for several hours. Then the voltage rapidly fell off to about 2V. Some rejuvenation was observed after an overnight rest but the voltage gradually and steadily dropped under load to the point of uselessness. However, with the intermittent type of operation we will be subjecting the battery to it should hold up for weeks.

Stacking several of these battery packages can produce many combinations of desired output voltages and current capabilities to power experimental ICs or other solid state devices where current requirements are only a few mils, or for higher current-short duration applications, such as the aforementioned TT pad.

Well, happy picture taking. . .and save those film packs !

... W3WTO

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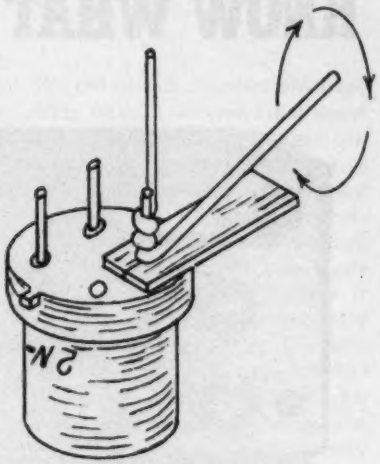
THE SCOTCH TRANSISTOR



Don't throw away those transistors on printed circuit boards. They can be salvaged at a very low cost. A good transistor can be had for less than a nickel by the method described here.

Some circuit boards are so thin and the leads cut so short, that the removed transistors are nearly useless. I have tried soldering leads to these transistors many ways without too much success. The leads either short to the case after mounting, or come loose when being soldered to the other components.

The method that I have found best is to take a small piece of cardboard and cut it down the middle for about 1/8 or 3/16 of an inch. This cardboard is then slipped onto the transistor lead. This cardboard will, in most instances, block solder from running down the lead into the transistor case. It will also space the new lead from the transistor. The new lead is a piece of 24 gauge tinned wire. The transistor is held upside down in a vise. The cardboard is added to one lead at a time. The tinned wire is started at the bottom of the transistor lead at the surface of the cardboard. A leader of approximately 2 inches is left on to aid in the wrapping of the tinned wire around the old transistor lead. I have found most transistor leads are long enough to get at least 2 full turns of wire around the lead. Now is the time to solder the transistor lead and the new lead together. Fasten a heat sink to the two inch leader. After the solder has cooled, hold the new lead taut, and twist the 2 inch leader off, using an upward pull. Remove cardboard and repeat for all leads. Inspect work, then cut all leads the same length. To mark the emitter lead, cut it 1/4 inch shorter. After the leads are dressed up, they are ready for potting.

A mini-cube plastic ice tray is used as the mold. The transistors are carefully placed into the ice tray. The epoxy is mixed and poured in. After setting, the new transistors are removed. The new leads can now be handled in the same way as leads on a new transistor. They will now be insulated from the transistor case, and will not affect the old leads, as they are held rigid by the epoxy. The little cubes look nice on a vector board. I was surprised to see just how neat they really looked.

...WA9VFG

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Circuit Description

Figure 1 shows the circuit diagram of the test generator. Basically, it consists of a string of SN7490 decade counters which are used to divide down a selected input signal by a factor of 10 or 2. The input signal can come from a 1 MHz master oscillator, a special crystal oscillator for externally used crystals or from any external sine-wave source. The special crystal oscillator which uses a SN7400 will operate with almost any basic or overtone crystal in the hf range. It can be used for crystals in the low frequency and lower VHF range also by a simple modification. One gate of the SN7400 crystal oscillator is used to drive a LED which will indicate that the crystal is oscillating so it serves as a crystal activity indicator as well. When an external sine-wave source is used, it is first coupled through a SN74121 multivibrator. This stage squares off the sine wave so it can better drive the subsequent frequency divider chain.

The frequency divider chain is fixed, although one could easily switch the individual SN7490 units to divide by different ratios when desired. This should be obvious

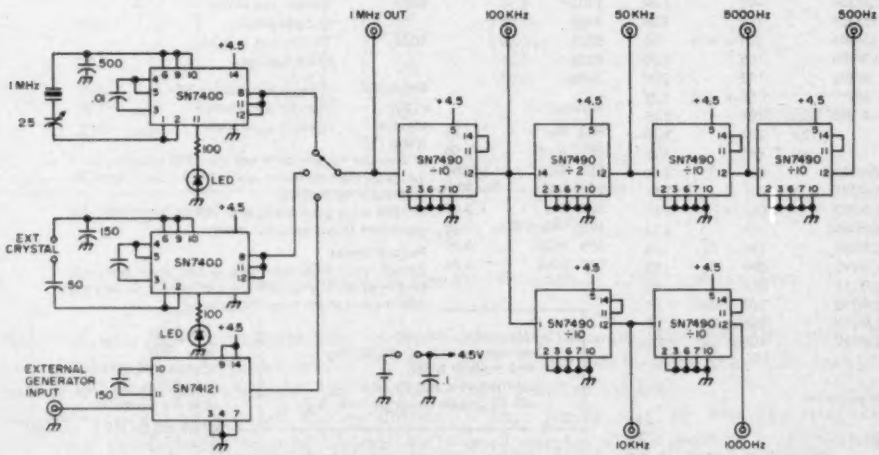

Fig. 1. Diagram of universal frequency generator. Output frequencies shown are for using 1 MHz oscillator.

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05	.30	48	2.00	122	.90	175	3.50
06	.50	50	.30	123	1.25	176	1.00
07	.70	51	.30	125	.75	177	1.00
08	.30	53	.30	126	.75	180	1.25
09	.30	54	.30	132	4.25	181	6.25
10	.30	60	.30	141	4.50	182	1.25
11	.30	70	.40	145	1.75	184	3.25
12	.70	72	.45	150	3.25	185	3.50
13	1.00	73	.60	151	1.25	190	4.50
16	.70	74	.60	152	4.50	191	5.00
17	.70	75	1.50	153	1.50	192	2.25
20	.30	76	.60	154	2.00	193	2.50
23	.50	83	1.25	155	1.50	194	2.50
25	.50	85	1.50	156	1.50	195	1.25
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by noting the wiring of the divide by 2 SN7490 with that of the divide by 10 units. However, the variety of frequencies which can be generated then with different input sources becomes confusing and more than would normally be needed.

The fixed divider chain follows the sequence: divide by 10, divide by 2, divide by 10, divide by 10. A separate branch after the first divide by 10 unit goes through two other divide by 10 stages. In the case of the divider chain being driven by the 1 MHz master oscillator, this results in the following output frequencies being simultaneously present: 1 MHz (basic oscillator output), 100 kHz, 50 kHz, 10 kHz, 5000 Hz, 1000 Hz and 500 Hz. With any other frequency input source you can easily calculate what frequency outputs the divider chain will bring in both the rf and af regions. Many surplus crystals will produce interesting frequencies of high stability in the af region that can be used for test purposes.

When using the special crystal oscillator, the LED will glow to indicate that oscillation is taking place. As shown with a 150 pF capacitor from one side of the crystal oscillator circuit to ground, the oscillator will work satisfactorily with hf crystals. Its range of oscillation can be extended to lf as well as high frequency overtone crystals by changing this capacitor. The value of capacitor required in picofarads is 500 divided by the frequency of the crystal in MHz. This value need, however, to be only approximate unless you require an absolutely square wave output from the unit.

When using the multivibrator input about a 1½ to 2V peak input, either sine-wave or approximate square wave is required.

Construction

The whole unit can be constructed on a piece of perforated board about 3 x 2 in. and made completely portable if powered by a 4½V battery (Burgess No.532) or just three D cells in series. This arrangement does not provide the absolutely best stability for the 1 MHz master oscillator but unless you intend to use the unit for marker frequency generation in the VHF range, it is a perfectly satisfactory arrangement. Alternatively, one could power the ICs from any standard 5.5V regulated supply used for IC digital circuitry.

I constructed my unit for battery powered operation and enclosed the unit in a small aluminum mini-box. The output of each divider was brought to a pin jack on the front panel of the unit.

One simple way to wire the relatively small number of ICs involved is to purchase perforated board which has hole spacing to fit standard DIP and preferably with a copper pad still left around each hole. The

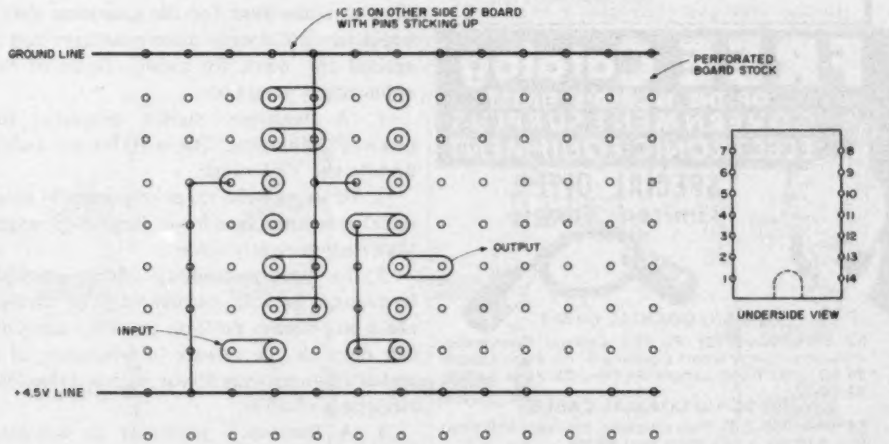

Fig. 2. Perforated board wiring of ICs. One SN 7490 divide by 10 unit is shown wired.

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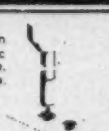

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ICs are then placed on the board and the appropriate pins which either go to ground or to the 4.5V line bent in different directions. The ground line is run along one side of the IC and the 4.5V line along the other side and bare wire used to connect the appropriate pins to either line. Figure 2, illustrates the wiring for one of the divide by 10 ICs. When one starts this process on the board, it will be surprising how fast the wiring is completed. Individual insulated wire jumpers are used to make the input/output connections between ICs. The wiring is not critical and using a receiver to hear the markers, or an audio amplifier for the lower frequency outputs, one should be able to determine quickly if the circuit is working. The frequency of the 1 MHz master oscillator may be brought exactly on frequency using the 25 pF trimmer in the circuit and checking against WWV with a harmonic of the oscillator or by using a counter.

Applications

As I mentioned before, the applications that you can find for the generator really begin to unfold only after you have had it around the shack for awhile. Some of the applications would be:

1. A frequency marker generator for receiver calibration. The markers are usable up into the VHF range.

2. To extend the range of present rf or af signal generators into lower frequency ranges than they presently cover.

3. To perform stability checks on high frequency variable oscillators. The divider chain will always perform precisely and you can monitor the change in frequency of a higher frequency oscillator with a stable low frequency receiver.

4. A frequency generator to generate precise rf or af square wave signals at any frequency desired by choosing the proper crystal.

5. A crystal activity checker.

6. By taking two or more of the simultaneous outputs together via mixing diodes and a series tuned circuit resonant at the desired frequency, you can also mix the divider outputs to generate a variety of intermediate frequency outputs.

...W2EEY

John C. Roos K61QL/N0ZIP
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UNIVERSAL AFSK GENERATOR

This article describes an AFSK tone generator which should interest any RTTY operator. It will work without modification in almost any local loop or with any terminal unit.

I have always felt that the two greatest shortcomings of most AFSK circuits have been cumbersome methods for adjustment of the tones to the correct frequencies and difficulty in adapting a particular circuit to an existing terminal unit. While some of the circuits based upon the Signetics 566 function generator have proved easy to adjust, the loop interface problems still exist. Many of these circuits do not produce a sinusoidal output waveform. This can mean severe adjacent channel interference if the transmitter audio bandpass allows transmission of tone harmonics. I believe that this circuit solves all of these problems and in addition is simple to construct. Circuit features include:

1. Plug-in operation in any RTTY loop independent of loop polarity or grounding.
2. Independent adjustments for each tone.
3. Constant amplitude sine wave output.
4. Excellent tone frequency stability.

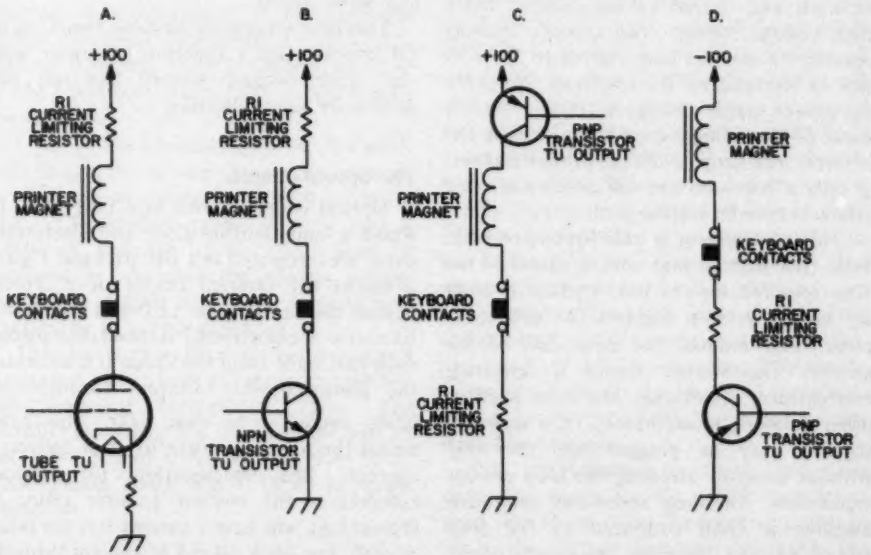


Fig. 1. Typical RTTY loop circuit: a – TU with tube output and positive loop supply. b – TU with NPN transistor output and positive loop supply. c – TU with PNP transistor output and positive loop supply. d – TU with PNP transistor output and negative loop supply.

Front view of the AFSK generator. Controls include the shift selector switch and the power switch. The loop input jack is isolated from ground with shoulder washers.

5. 850 or 170 Hz shift operation with narrow shift ID.
6. Output adjustable from 20 millivolts to 2 volts peak to peak.

The RTTY Loop-AFSK Oscillator Interface

Most amateur RTTY loops are some form of Fig. 1. The machine keyboards and printer magnets are placed in series with the terminal unit output keying element and a high voltage supply. The current limiting resistor R1 sets the loop current to 20 or 60 mA as required by the machines. Normally the power supply voltage is 100V or so and most of the voltage drop occurs across the resistor. The drop across the printer magnets is only a few volts and the closed keyboard contacts have no voltage at all.

This arrangement is used for two reasons. First, the high voltage source decreases the time required for the loop current to built up in the printer magnets for each code pulse. This reduces the error rate of the printer. The second reason is operating convenience. Additional machines such as other printers, reperforators, or a tape distributor may be plugged into the loop without seriously affecting the loop current adjustment. The drop across any additional machine is small compared to the drop across R1 and therefore the loop current change is negligible.

The high voltage loop is all good and well for the machines themselves, but can cause real difficulty when an AFSK oscillator containing tender semiconductors must somehow be connected into the system. Further, each fellow's station is different. Depending on the particular operator, there may be one or more local loops and several terminal units. It is not uncommon to find that the serious RTTY operator has a Mark IV, a Mainline, an ST-6, plus some old military gadget such as a CV-57 . . . all operational and powering one or more machine loops. Because of the differences in the various pieces of equipment, the AFSK oscillator design must contend with systems in which the loop voltage may be of either polarity. The machine end of the loop may or may not be ground referenced, and the loop supply may be anything from 24 to 200V. Thus, a special interface circuit is required to allow operation of the typical AFSK oscillator with each terminal unit.

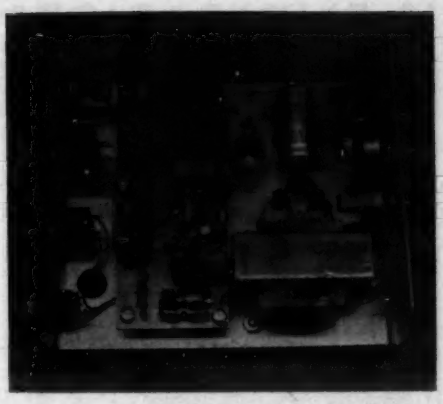
Having encountered all of these problems when hooking up RTTY systems for myself and for friends, I decided to design a circuit which, like any other piece of RTTY equipment, just plugs into the loop and works. In addition I wanted the circuit to have good frequency stability and a constant amplitude sine wave output.

Two new integrated circuits, the IC optical coupler and a function generator with sine wave output, seemed like just the devices for my application.

The Optical Coupler

Optical couplers are a new type of IC in which a light-emitting diode and phototransistor are integrated in a DIP package. Figure 2 shows the internal circuit of a typical optical coupler IC. The LED and the phototransistor are electrically isolated, but placed such that light from the diode is focused on the phototransistor. Current through the diode causes it to emit light. This light causes the phototransistor to draw collector current. One specification for optical couplers is the current transfer ratio. A typical unit will have a current transfer ratio of 60%. For every 10 mA of current through the LED 6 mA will flow from the emitter to collector of the phototransistor. Couplers are also specified for the maximum voltage

allowed between the LED and phototransistor; 1000V is not unusual. The optical coupler is the ideal device for coupling current pulses from the RTTY loop to the AFSK oscillator without any electrical connection between the two. All voltage, polarity, and grounding problems are eliminated with this simple method.



Interior view of the AFSK generator. The tone frequency adjustment pots are positioned so that they may be adjusted through the vent holes in the side of the case. The tone output and narrow shift key jacks located on the rear panel with the tone level adjustment pot.

The Intersil 8038 Function Generator

The tone generator portion of the AFSK oscillator uses the new 8038 function generator IC from the Intersil Corporation.

Operation of this circuit is similar to the Signetics 566 function generator which has been used in previous amateur AFSK circuits. There is one important difference, in addition to the triangle and square wave outputs obtainable from other circuits, the 8038 also produces a *sine* wave output.

The basic RC oscillator portion of the chip generates a triangular wave form. This is transformed into a sine wave by means of a triangle-to-sine converter integrated onto the same chip. Special trimming adjustments are provided so that the distortion may be reduced by optimization of the converter circuit. Harmonic distortion is about 5% without trimming. Careful adjustment of all of the optional controls will reduce this to less than 1%.

If all of the trimming pots are not used, only three external components are required to make a basic voltage controlled oscillator. The VCO control range is such that a frequency shift of up to 100:1 may be obtained by changing the control voltage input. The output amplitude remains constant as the frequency is shifted.

The chip is available in six versions which are graded on the basis of frequency stability and operating temperature range. The 8038BC used here has a maximum drift of 100 ppm/°C and is usable from 0 to 70°C. This version costs about $8.40 in single quantities.

AFSK Generator Circuit

The AFSK generator circuit is shown in Fig. 3. It is connected into the RTTY loop via a phone jack. In order to make the circuit truly independent of loop polarity, the current first flows through a bridge rectifier consisting of CR1-CR4 and then through 6V zener diode CR5. The bridge supplies the zener with current of the proper polarity such that a constant voltage drop occurs across the zener which is independent of both loop current and loop polarity. A ¾W zener is used so that the circuit will operate with loop currents from 10 to 100 mA without damage. The bridge-zener diode combination then drives the optical coupler from an essentially constant voltage source.

The optical coupler is a Motorola MOC 1003 and is operated at an input current to the LED of 10 mA. This is set by R5. The phototransistor or output side of the coupler is grounded to the AFSK generator while the entire input circuit consisting of the bridge, zener and the LED are floating. The voltage difference between the loop and the AFSK circuit can be up to 500V before the coupler would be damaged.

The phototransistor drives the tone generator circuit via Q1 which operates as logic inverter to cause the frequency shift to be in the correct direction. Normally, the MARK (or closed loop) tone is 2125 Hz and the SPACE (or open loop) tone is either 2295 or 2975 Hz. The frequency shift is upward when the loop current is broken or

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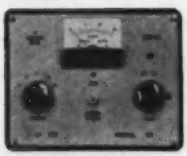

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keyed by the keyboard pulses. An upward frequency deviation is obtained from the VCO chip by decreasing the control voltage input at pin 8. This is done in the following manner: When the machine is at rest, loop current flows and the LED in the coupler is driven on. The light from the LED causes the phototransistor to be driven into saturation such that the collector-to-emitter voltage drop is about 0.5V. Q1 is turned off because its only source of base drive is via the 33K resistor, R6, and about 1.4V are required to overcome the forward drop of CR6 plus the turn-on threshold of Q1 itself. Because Q1 is off, the control voltage input to the tone generator IC is determined only by the voltage divider of which resistor R1 is

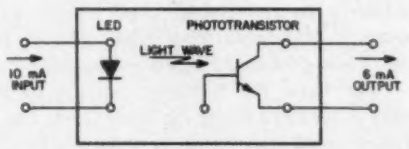

Fig. 2. Internal circuit of optical coupler IC. The input and output devices are completely isolated from each other. 10 mA through the light emitting diode will produce a current flow of about 6 mA from collector to emitter of the phototransistor.

a part. R1 sets the MARK frequency to 2125 Hz.

Each machine code pulse reduces the loop current to zero. The LED no longer has a source of current so the phototransistor in the coupler no longer conducts. The collector voltage rises until base current flows into Q1 causing it to saturate hard; the collector-to-emitter drop is less than 0.3V. The collector current for Q1 is obtained from the frequency setting pot R1 via resistors R3 or R4. This pulls down the voltage at pin 8 of the function generator IC and causes the frequency to shift upward. Switch S1 selects either R3 and its associated fixed resistor for 850 Hz frequency shift or R4 for 170 Hz shift.

Adjustment of the 100 cycle shift for CW ID is provided by R2, which is switched to ground by the key jack.

The basic frequency range of the function generator IC is set by R7 and C1. Other

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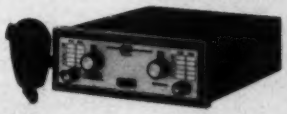

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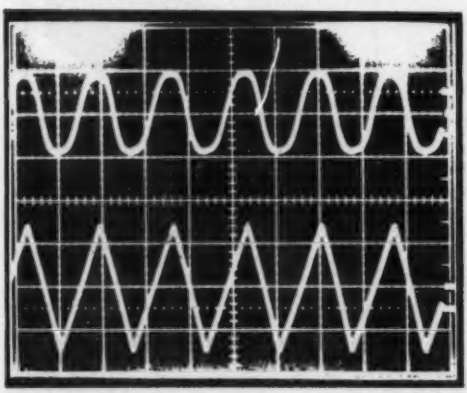
values may be used. The sine wave output terminal of the chip is pin 2. The triangle is present across C1 at pin 10. The sine wave output is AC coupled to the output level adjustment pot, R8, and then to the output buffer amplifier which is a 741 operational amplifier. The 82K resistor, R9, is used to trim the sine converter in the chip for lowest distortion and is a nominal value.

The level set pot, R8, is 250K because the sine converter should not be operated into less than 100K if lowest distortion is to be obtained.

The output buffer, IC2, is operated from a single polarity supply so the inputs must be biased between the supply voltages. R10 and R11 accomplish this for the non-inverting input at pin 3 while the inverting input, pin 2, is biased with feedback from the output at pin 6. This is a unity gain buffer connection which enables the tone generator to drive loads of less than 1K. The output voltage may be adjusted from 20 mV peak to peak to 2V peak to peak. Inclusion of the buffer is a bit of a luxury, but it does assure that the unit may be used with just about any transmitter and the low impedance output is nice if a long cable must be driven.

Power Supply

The power supply section of the AFSK generator is conventional with the exception of the voltage regulator. The transformer and bridge provide about 24V unregulated across the filter capacitor. The regulator is a new single voltage regulator IC from Motorola. This chip, type MC7818CP, is a fixed 18V regulator capable of up to one ampere of output current. It is one of a series of low cost regulators available in standard voltages such as 5, 12, 15, etc. Only three connections are required: input, ground and output. A bypass at the input is a good idea if the lead from the rectifier filter capacitor is long. While the one amp capability of the supply is much more than this circuit required, the ease of application and good performance of the regulator more than justified its use. Particularly since it costs less than $2!



Function generator waveforms. The bottom trace is the triangle wave generated by the RC oscillator portion of the 8038 function generator. The upper trace shows the sine wave obtained from the triangle to sine converter without optimization of the external trimming adjustments.

Construction

I intended this circuit to be a stand-alone unit which could be used with any terminal unit or local loop. Consequently, it is packaged in a small sheet metal case and has its own ac power supply. Others may wish to build it into an existing system from which power may be obtained. Anything from +15 to +20V regulated will work.

The majority of the circuitry is constructed on a small PC card sub-chassis which may be seen in the photograph of the interior. The most frequently used inputs and controls are located on the front panel and include the loop input jack, the shift selector switch, the ac power switch, and a pilot light. Rear panel controls include the narrow shift ID keying jack, the tone output jack, and the tone output level adjustment pot. Be sure to isolate the loop input jack from ground with insulated washers! The power supply is located on the main chassis.

Care should be taken in installation of the regulator IC in order to assure that it is not shorted to the chassis by the mounting screw or a sheet metal burr.

Starting from the bottom of the card, components are arranged in the following order: First is the input bridge rectifier and the zener diode. Just above is a DIP socket containing the MOC 1003 optical coupler which is in a 6 pin package. The pins are counted around the package starting with

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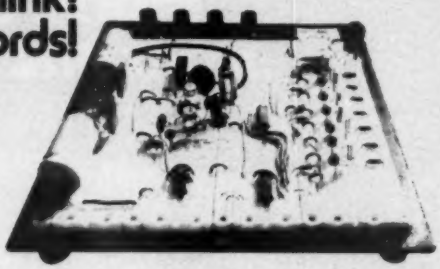

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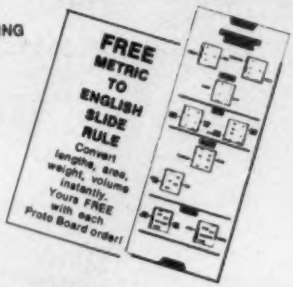

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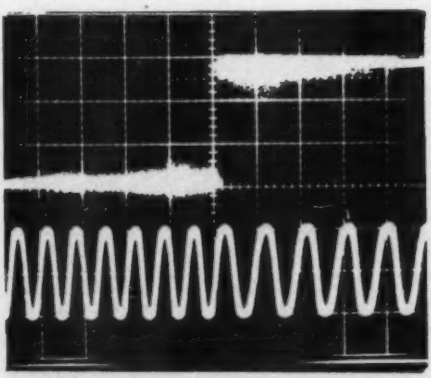
pin 1 at the index dot and are sequential as in the case of a standard 14 pin package. That is, they go 1 to 3 down one side, then jump across to pin 4 through 6 going back up the other side. Q1 is located just above the coupler socket while the frequency adjustment pots are just to the left of Q1.



Frequency shift waveforms. Top trace shows input current waveform switching from SPACE to MARK. Bottom trace shows AFSK generator tone output switching from 2975 to 2125 Hz. No transients are present and the amplitude remains constant. Output is 2V peak to peak.

All of the resistors associated with the frequency adjustments are stable metal film types such as the MIL RN60 series. Conventional carbons may be used but the stability just won't be as good.

I used surplus wirewound trimmer pots for the frequency adjustments. The 20 turn resolution is a real help in setting up the circuit, but again, single turn pots will work if you have a steady hand!

The function generator IC is located above Q1. A 14 pin socket is required for this circuit also. The timing components are located around the function generator socket. I bring the pins on the IC socket through the board via wires to push-in type feedthrough standoff terminals. The components are mounted on top of the card and are easily accessible. In addition, the larger terminals are easier to connect to than the tiny IC socket pins.

The 741 output buffer amplifier is located near the top edge of the card as shown in the picture. All input, output, and power

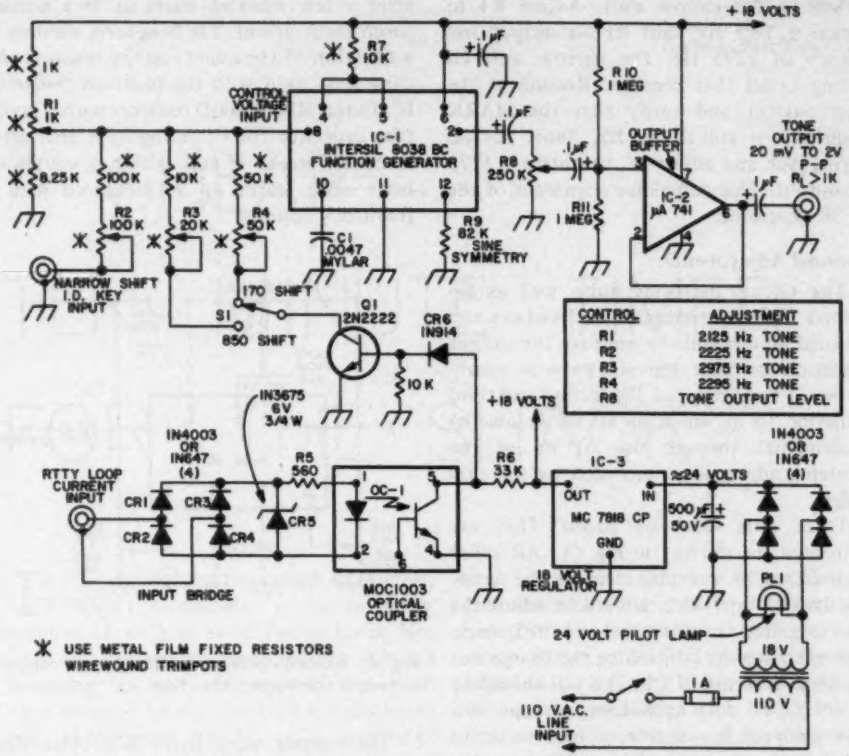


Fig. 3. Circuit schematic of the universal AFSK generator.

connections are made to the feedthrough standoffs on the underside of the card. The card itself is mounted above the main chassis on half inch spacers.

Circuit Alignment

After assembly, take a minute and check the wiring, particularly the connections to the two ICs. More chips are ruined from counting the pins from the wrong side than probably from any other cause.

Remove the 8038 function generator from its socket. Apply power and verify that the IC regulator output is 18V. Then check to see that this voltage is present at pin 6 of the 8038 function generator socket. Also check that R1 adjusts the voltage at pin 8. This voltage should never be less than three-fourths of the supply voltage. Remove power and install the 8038 chip in its socket. We are now ready to set up the tone frequencies. Provide a 20 to 60 mA constant current source such as a RTTY loop. Connect this to the loop input jack. Do not attempt to drive the loop from a constant voltage source such as a lab supply without providing a current-limiting resistor. A small increase in input voltage will cause a large current to flow through the bridge and input zener CR5, since the circuit contains no internal current-limiting resistor.

Set the output pot, R8, to maximum and connect a counter, TU, or other frequency measurement device to the tone generator output.

With loop current applied to the input jack, set the MARK frequency adjustment, R1, so that a 2125 Hz output is obtained.

Set S1 for 850 Hz shift and remove the loop current. Now set R3 for a SPACE frequency output of 2975 Hz. Leave the loop current disconnected.

Set S1 for narrow shift. Adjust R4 to obtain a 170 Hz shift or an output frequency of 2295 Hz. The narrow shift ID setting is all that remains. Reconnect the loop current and verify that the MARK frequency is still 2125 Hz. Short the ID keying jack and adjust R2 to obtain a 2275 Hz output. This completes alignment of the AFSK generator.

Optional Adjustments

The circuit performs quite well as described. The experimentally inclined can add optional adjustments to improve the output distortion so that the sinewave is nearly perfect. I have reduced the second and third harmonic to as much as 50 dB below the fundamental through use of all of the trimming adjustments provided by the chip design.

Three pots must be added. They are connected as shown in Fig. 4. All other connections to the chip remain the same. The 1000Ω pot, R12, is used to adjust the time symmetry or duty cycle of the triangle wave generator by controlling the charge and discharge currents of C1. The pot should be set for a 50% duty cycle using a scope. If a wave analyzer is available, it may be set to null out the second harmonic. This null is quite sharp.

R13 and R14 are used to adjust the amplitude symmetry of the sine converter. One pot adjusts each half cycle. Start with each pot at center position and adjust carefully for best wave form symmetry or minimum third harmonic distortion. This circuit is recommended by the IC manufacturers, but should be used with care so that the pot wiper does not go completely to the end. It might be possible to damage the sine converter by sinking or sourcing too much current to the chip from the supply or ground. Used with care it works fine.

Performance

Like most anyone, I like to make a few tests to see if my brainchild works as well as I think it will. The AFSK generator was subjected to several tests to verify performance. The frequency stability is quite good. The unit is about 5 Hz low when first turned on from cold, stabilizes within 1 Hz after a few minutes warm up in a normal room environment. The long-term stability is a function of the quality of the resistors and capacitors used with the function generator IC. I used MIL RN60D resistors with a mylar film capacitor for C1. Long-term drift after some six weeks is still within a couple of hertz after warm up as measured with a frequency counter.

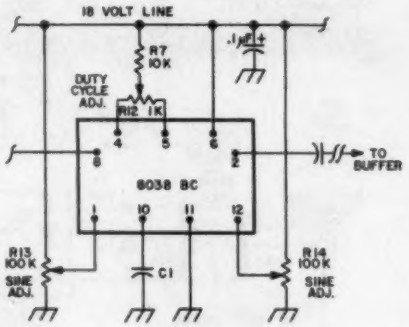


Fig. 4. Function generator with optional controls to reduce sine output distortion.

The output wave form is a clean sine wave and no clicks or transients are present when the circuit shifts from MARK to SPACE. The scope camera photograph shows the input switching waveform on the top trace and the resulting frequency shift on the bottom trace. This particular picture shows the shift from 2975 Hz back to 2125 Hz. There are no transients present and the sine wave amplitude does not change at all.

I also measured the harmonic distortion present in the output sine wave. Without adjustment of the 82K resistor, it is about 5%. Careful trimming will reduce it to below 3% which is good enough for most amateur RTTY applications.

The optically coupled input circuit worked quite well. The shift from MARK to SPACE occurs as the loop current drops below 5 mA which leaves plenty of margin for the fellows with 20 mA loop systems. The unit is truly universal. It does work with any local loop or TU, provided there is sufficient loop current.

. . . K6IQL/NØZIP

Robert Perlman WB2VRW
3 Joslen Place
Hudson, New York 12534

A CHEAP TEN MINUTE TIMER FOR THE SHACK

In his editorial for the month of August, W2NSD/1 commented on the amateurs' habit of identifying every two minutes. Not only is this habit unnecessary, but it's annoying, as well. Fortunately there's an easy solution in the form of a timer using one IC (Signetics NE555) and a handful of other components. Practically every repeater control circuit recently appearing uses some NE555s in the timing line, but relatively little has been said about its use by the average amateur. There's certainly nothing novel or original about the circuit that follows, as a similar circuit appears in Signetics' catalog. But many hams don't have access to catalogs and the like, and this article is meant for them.

The circuit is shown in Fig. 1. In the wiring configuration shown the NE555 acts as a monostable multivibrator. The timing is determined by R1 and C1, where the length of the timed interval is equal to 1.1 R1C1. It should be mentioned at this point that it's necessary to use a low-leakage capacitor for C1, or else the length of the interval will differ considerably from the value given in the equation. Also, be sure that R1 is less than 20 meg-ohms.

When S1 is pushed, pin 3 of the output goes high, and remains so until the end of the time period. If S1 is pressed during the time period, the timer resets and begins counting a new interval. Pin 3 can source or sink 200 mils, which means that any device which draws up to 200 mils at 9V can be attached to the pin. If it's desired to have the device on during the timed interval, hook it up to points A and B, and to points A and C if the device is to turn on at the end of the interval.

In my set-up, an LED is used as the indicator. Most LEDs operate on two or three volts, so it's necessary to add a

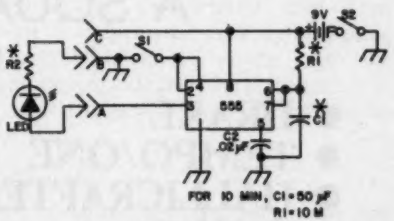


Fig. 1. Schematic of the 10-minute timer. See text for a discussion of R1, C1 and R2.

dropping resistor, R2, the value of which is equal to $\frac{9 - V_{led}}{I_{led}}$; where V_{led} and I_{led} are the LED's operating voltage and current, respectively. The same formula holds true for any device which operates on 9V or less.

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A LOW FREQUENCY PHASED ARRAY

As a confirmed 80m type I have always resisted the urge to put up a truly superior antenna system for that band. Finally, last summer I decided to respond to the creative urge by constructing a system which would offer advantages over a simple dipole and which would also include sufficient flexibility to permit direct experimental comparison of a number of antenna configurations which are of interest. This article reviews the approach, the results and the current status of those experiments.

This antenna system provides effective gain and front to back ratio on 80m with switch-controlled directivity and angle of radiation.

The Approach

Consideration of space limitations (2/3 acre) and other practical constraints led to the choice of two parallel dipoles as the basic elements of the array. Since it was desired to switch to a unidirectional pattern and also to control the angle of maximum radiation, direct feed, rather than a parasitic array, was chosen.

Reference to the radiation patterns in the handbooks shows that a unidirectional cardioid (heart-shaped) pattern can be obtained in an end-fire array of two parallel elements, with a spacing of $\lambda 1/4$ and fed with a 90° phase difference. The radiation pattern in this case is a reversible cardioidal pattern with maximum gain in the direction of the lagging dipole element. This cardioidal arrangement was chosen as the basic horizontal directional array with other related options available by switching.

It is of interest to provide, in addition to the reversible cardioid, a 45° lag (higher radiation angle), a 0° lag (highest radiation angle – 90°), and 180° lag (8 JK configuration – low angle, bi-directional) and, for comparison purposes, each of the two dipoles separately. This is a total of eight different pattern options!

Still in the experimental stage is an attempt to achieve the same options using ¼λ vertical radiators. Thus far, with the ground system available, the performance of the vertical system is uniformly inferior by about 10dB.

The Circuitry

The circuitry for the horizontal and vertical phased arrays is shown in the schematic diagram, Fig. 1. Instantaneous switching from one pattern to another is achieved by only three switches: a main selector switch S, the reversing switch X, which permits 180° phase reversal, and the 4PDT switch for changing between the horizontal and the vertical arrays.

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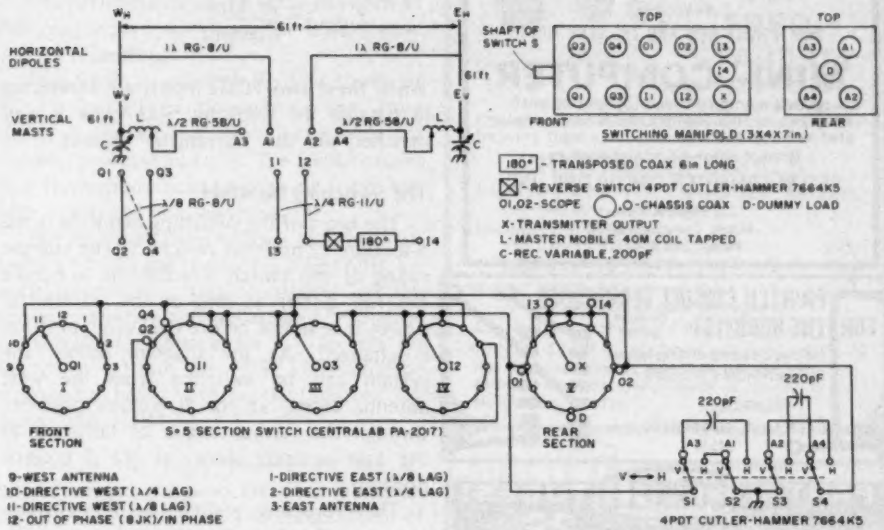

Fig. 1. Horizontal and vertical phased array circuitry. Only three switches need be used for instantaneous switching. See text for details.

The Horizontal Dipoles; the Verticals, Impedance Matching and the Switching Manifold.

The Horizontal Dipoles

The original installation utilized two dipoles as described previously.[1] The centers were 14.02m above the ground with a horizontal spacing of 18.6m. The RG8/U feedlines, one wavelength long, were inside the masts with the balun action and lightening protection as previously described. This original arrangement gave very good operation.

However, since it was desirable to have the lowest possible angle of radiation the centers of the two dipoles were raised to 18.6m (λ1/4). This was accomplished by lengthening each steel mast by the addition of 9.14m length of 7.62cm diameter aluminum irrigation pipe at the bottom end of the mast. The steel mast is inside this pipe and the overlapping portion is bolted securely by use of .64cm plated bolts through the pipe and mast in perpendicular pairs. (No. 8 self-tapping screws in the steel mast served to space the mast within the pipe radially before the bolts were put in place.)

place.)

No data could be taken for comparison of these two heights but it is assumed that the 18.6m height yields a somewhat lower angle of radiation for each pattern option.

The Verticals

The 18.6m foot masts are fed as top-loaded verticals. The horizontal dipoles are connected to the top of each mast and the two halves of each dipole are connected together by shorting the opposite end of the 1λ feedline.

Referring to the diagram, all of these connections are switched by means of the 4 PDT switch. This permits the selection of all of the vertical phasing options by the selector switch S just as for the horizontal system.

The resonating and impedance matching of the verticals is accomplished by the capacitors C and the inductors L. A noise bridge was used to insure adjustment to 52Ω resistive input at 3.955 MHz.

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The 220 pF fixed mylar capacitors connected across the feedlines of the verticals, during use of the horizontals, serve to tune out residual reactances for optimum SWR to the horizontals.

When full lightening protection is desired the bottoms of the masts are connected directly to ground by means of copper jumper cables. With this connection the horizontal array can be used with dc paths to ground from both sides of each dipole, giving full protection against build-up of static charge.

Impedance Matching

The feedline input impedances are 52Ω resistive at the resonant frequency (3.955 MHz). It is necessary to switch-in phase lag by inserting a length of 52Ω line in either of these feedlines, as desired, and to feed equal currents to both dipoles while maintaining a 52Ω match at the transmitter output.

This is accomplished by use of two ¼λ transformer sections of RG11/U (75Ω) coax. These serve to transform the 52Ω antenna input impedance up to 108Ω by the relation:

$$Z_{input} = \frac{Z^2 \text{ Line}}{Z_{output}}$$

When these two 108Ω inputs are connected in parallel the resulting 54Ω value is well matched to the transmitter output.

The Switching Manifold

The heart of the switching manifold is the 5-section 12-position switch, S. The current rating of this switch is sufficient to handle the full power as long as the transmitter power is removed before the switch position is changed. As the diagram shows, the system can be switched from the west antenna alone, at the 9 o'clock position, through the various angles of radiation to the east antenna alone, at the 3 o'clock position.

The reversing switch permits instantaneous switching of patterns, for example, from east to west, without having to turn the selector through the intermediate positions.

Only four of the twelve switch positions are not used: 4, 5, 7 and 8-o'clock. The 6 o'clock position is used for a dummy load.

The switches are mounted in the 7.62 x 10.16 x 17.78cm aluminum chassis box with the sixteen coax sockets as shown. The box is mounted under a projecting top of the operating desk. The four lengths of coax used for matching and delay lines are wound on a wooden reel and placed inconspicuously behind the desk.

The connectors 01 and 02 provide inputs to the vertical and horizontal plates of an oscilloscope for a lissajous display of the inputs to the two antennas. (The integral scope in the CE 100V transmitter is used at W20ZH). Thus, the phasing and the amplitudes of the rf voltages can be continuously monitored, allowing any change in either antenna to be immediately noticed.

The scope shows a circle for the cardioidal patterns, diagonal lines for in phase or out-of-phase, and a flattened ellipse for either antenna alone. (This pattern is elliptical rather than a straight line due to the rf energy picked up by the non-energized antenna).

Performance

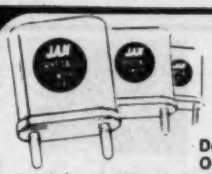
The performance of the array has been all that was hoped for, both for transmission and for reception.

The SWR is consistently low (under 1 1/2:1) for all configurations. The array shows a broadband behavior typical of coupled resonant circuits. The SWR remains low throughout a bandwidth of some 400 kHz – only the phasing varies.

The measured front-to-back ratio is of the order of 15dB and the gain is about 4dB, for both transmission and reception. The improved operation for low angles of radiation is sometimes spectacular – as net of California stations on .3952 kHz could be repeatedly heard and worked during the winter at 9:30PM E.S.T.!

One of the most pronounced characteristics noted has been the great reduction of QRM for reception. The combination of the high front-to-back ratio and the low angle of radiation serves to reduce the level of some signal strengths while increasing the level of others. Thus, there is often at nighttime, a sort of single-signal performance which is very gratifying. (It should be gratifying to the stations off the back of the pattern too!). This single-signal selectivity of the antenna system is particularly impressive when the station being worked also has a low-angle directive antenna system. In this case the directivities complement each other with spectacularly strong signals at either end.

For the type of operation prevalent at W20ZH the two cardioid patterns are used more than 90% of the time. Frequently the out-of-phase (W8JK) bi-directional configuration is used for calling CQ and the proper cardioid pattern is used for the ensuing contact. Under normal conditions there is little need for a linear amplifier, once contact has been established. The principle directivities are in the east and west directions so stations to the north or south are seldom worked. The 0° or 45° phase shifts and the single dipole patterns seldom show consistent superiority over the cardioids. It is interesting to listen to two stations on the same frequency which have about equal signal strengths, when one is to the east and



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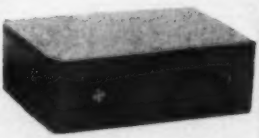

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the other to the west. Either signal can be selected at will by switching the cardioid patterns and the unwanted signal is barely audible in the background!

Such an array would be a great boon to stations located on the coasts as the 3dB of power wasted out over the water could be largely utilized.

The only disappointment thus far has been the consistent weakness of signals from the vertical antennas. The separate vertical antennas are typically down about 10dB compared with the horizontals and this inferiority carries over to the vertical array, regardless of direction or distance. The poor performance of the verticals is attributed to ground losses, with attendant high radiation angles, in spite of the fact that a parallel grid of about 1066.8m of ground wire is used. Perhaps this explains why so many writers describe their 80m vertical constructional features at great length with hardly any space devoted to results. Maybe the results were unprintable!

Weather and motivation permitting, I plan to experiment further with improved radial grounding and I hope to get some meaningful quantitative comparisons. Meanwhile I will be skeptical when I hear of a "superior" 80m vertical with only a modest ground system.

Conclusions

A 2-element horizontal phased array for 80m has been constructed with a total of eight pattern options available by direct switching. Operating results have confirmed the expected gains and front-to-back ratios. The performance of the unidirectional cardioidal patterns has been particularly effective, especially when the station being worked also has a directive antenna system.

Preliminary results using a vertical array with similar pattern options have not been encouraging, apparently due to high ground losses. Further experimentation on this system is planned.

W2OZH

[1] "Construction of a Balanced Dipole Antenna;" 73 Magazine, October 1972; P. 57ff. James E. Taylor.

Bill Hoisington K1CLL
Embassy Village
Muntinlupa Rizac
Philippine Islands

DC ISOLATION

It is best to plan ahead a little for the dc organization of your complete solid state portable UHF station so that you don't find yourself connecting a negative battery terminal to a box that already has the positive wire on it. It happened to me!

There are a few units involved you know, like a low-noise rf stage, a second rf stage for image reduction, a mixer, a local oscillator, first i-f, tunable i-f, selective i-f, af amplifier, crystal-controlled exciter, rf power stages, and modulator. These are taken up and examined in turn as we deal with the bypassing and dc ground question. Good working examples of dc isolated 432 MHz amplifiers are detailed.

The dc question. Nowadays, with solid state devices, we're right back at the old stand where the 201A tubes used to have us – $5 each, 6V directly-heated filaments, and storage batteries. With solid state converters, rf stages, i-f strips, exciters, rf power amplifiers, modulators, and cables, you've got to make up your mind before you start building whether you're going to use a positive or negative ground. The dc ground deal is further complicated by the bypass question as you go up through UHF toward microwaves.

The low frequency units can be arranged pretty well with those little electrolytic and high K ceramic bypass capcitors (see tests on same later), but where trouble really starts is in the transition range near 432 MHz. Here, and increasingly so as you go on up through to 1296 MHz, no leads can be tolerated on the bypasses. You *must* use flat built-in capacitors.

We will take you through the whole bypass and isolation story, from 135 kHz up into microwaves, so that you can plan your dc ground and modulation affairs *on paper* first.

A list of some of the specific problems follows:

1. The value and size of bypass capacitors, beginning at 135 kHz, because you would like a good low-cost selective receiver, I'm sure.

2. When to use electrolytics and when you can do without them.

3. The UHF transition region, where you

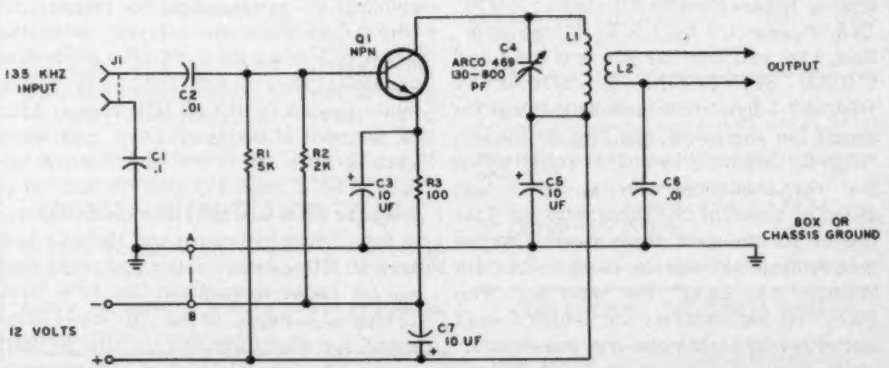

Fig. 1. VLF test circuit. I-f stage, 135 kHz.

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should begin to build your own lead-less capacitors.

4. The connecting cable outer conductor dc question.

5. How to build 432 MHz amplifiers whose groundplane-baseboard, box, and connecting cables don't have dc on them.

6. A word about 1296 MHz and up.

High-K, real small bypass capacitors are invaluable. Lafayette Radio has done a good job on bringing in low-priced subminiature ceramic bypass capacitors. I quote, "500 pF, 75 volts, size 1/8 by 1/8 by 1/16th inch." Now, I ask you, how can you beat that? And "10,000 pF, 5/16ths by 5/16ths by 5/64ths." I have used these little things for almost ten years now, and they do the job. "High-K" ceramic is used. This simply means that the insulation material has a high dielectric constant compared with air. Like five or six thousand times more! Granted that temperature-wise it changes, but for bypasses who cares? The specs say "Plus 100%" on high temperature, which doesn't matter as long as they also say "minus zero," which means that they don't drop *below* the initial rating. That is, they may increase, but they don't go down, in pF.

Some checks and a test run here on VLF, 10 meters, 2 meters, UHF, and into microwaves may help you to decide what bypass to use at what frequency. It already has helped me with my work.

These tests also tend to answer the question of overall circuit design of a crystal controlled, selective, portable station, for UHF in particular.

VLF. A low frequency i-f stage was checked to see just how much emitter and collector bypassing was actually needed in the kHz range. Figure 1 shows the test circuit, forming part of a low-cost i-f stage on 135 kHz, with a selectivity of a few kHz.

In Fig. 1, C3, the emitter bypass, and C5, the collector return bypass, are the units requiring attention. It was found that C3 needed the largest amount of capacity, working all right with 1 μF, but showing an increase of 5 to 10% in gain with 4 μF. Eight to ten μF was the value finally decided on for both C3 and C5. Subminiature electrolytic capacitors are available from Lafayette Radio which can be used for these purposes. Remember that you do not have the full battery voltage across the emitter resistor. A 6V rating will suffice here for C3.

There are some extremely tiny electroyltic capacitors made in the USA, but they run to more money, and will be taken up at another time.

The ten meter region. This can be of considerable importance because it is a good frequency to use for a tunable i-f when building a crystal-controlled receiver for UHF. Converters are all very well, but somewhere down the line you've got to tune something! Here we will touch on the bypass values needed for the 30 MHz region. After all, no need of taking up a ½ x ½ in. space when a little job 1/8th x 1/8th will do, right? The rf stage was used for this test as being the most susceptible to oscillation due to insufficient bypasssing and also as a base for a 30 MHz i-f strip in case you might need one for higher frequencies, like 1296 MHz.

Figure 2 shows details for an rf stage tested for this parameter in the 30 MHz region. Checking for both rf and i-f usage, because there can be a difference between a

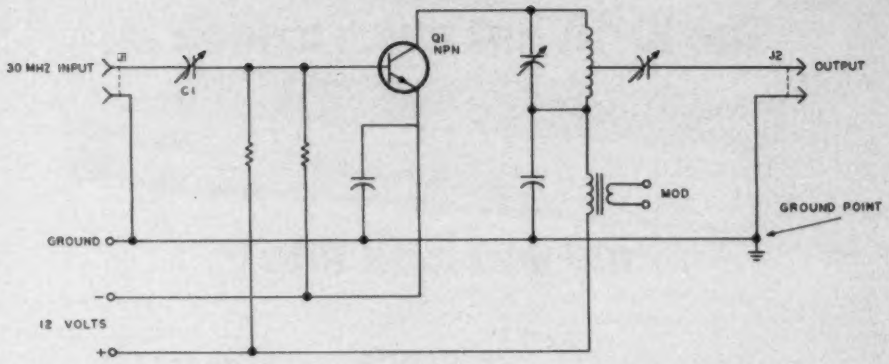

Fig. 2. Test circuit, 30 MHz region. Note. The "ground" point may be connected to either the positive or negative battery terminal, or left open dc-wise.

and up to 144 MHz for rf, that I've included details on the circuit for you. Four variable trimmer capacitors are shown and they are all useful. C1 matches the input cable, along with the tap on L1. C2 tunes L1 and the base tap on L1 completes the input circuit.

The collector coil L1 is tuned by C5, and tapped down for C6, the output matching capacitor. Excellent loading and control of feedback is obtained, with high gain and good stability.

single tunable rf stage and multiple fixed-tune stages as in an i-f amplifier, it appears that the value of .001 which is 1000 pF is sufficient for both C2 and C3. If you want to be absolutely sure, use 5000 pF. They are almost identical in size and price.

VHF, 120 to 144 MHz. I was going to jump from ten meters to UHF, but just couldn't let my old favorite two meters go by because I have ideas on a general purpose i-f strip to follow microwave front ends for

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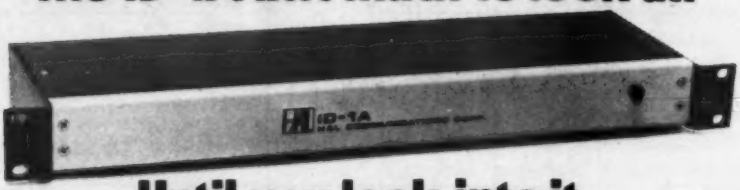

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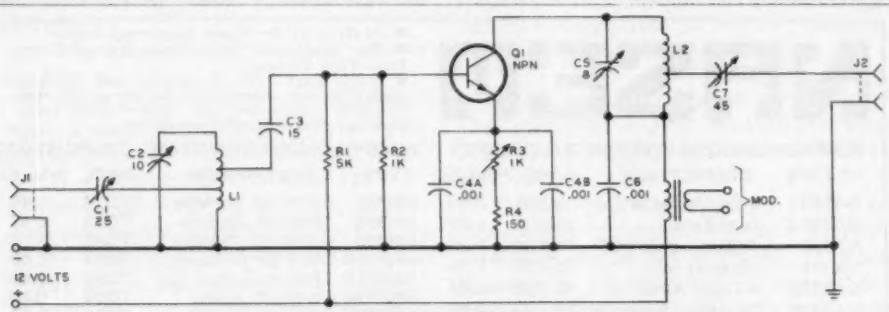

Fig. 3. Excellent 120 – 144 MHz amplifier.

amateurs somewhere in the 100 to 200 MHz region. Very useful.

Fig. 3, shows an excellent general purpose amplifier around six and two meters with emitter and collector return bypasses suitable for use with a negative ground. This turned out to be such a fine job for the region of 120 MHz as a microwave i-f strip, and up to 144 MHz for rf that I've included details on the circuit for you. Four variable trimmer capacitors are shown and they are all useful. C1 matches the input cable, along with the tap on L1. C2 tunes L1 and the base tap on L1 completes the input circuit.

The collector coil L2 is tuned by C5, and tapped down for C6, the output matching capacitor. Excellent loading and control of feedback is obtained, with high gain and good stability.

The emitter bypass showed the preference for more than one capacitor. This business of a jump in gain when bypassing the emitter with a second capacitor is not new. However, a brass plate capacitor such as I use on 432 MHz and up did not help on this 120 MHz amplifier. This is evidently the beginning of a transition region where the

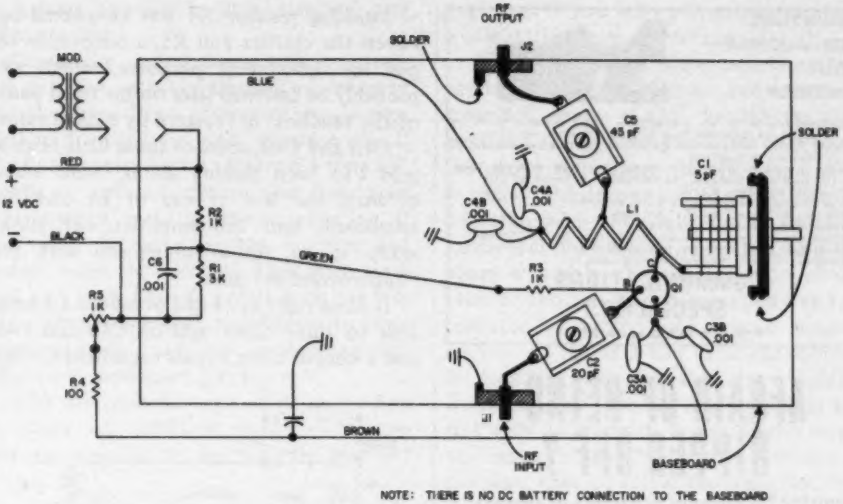

Fig. 4. 432 MHz amplifier using coil and capacitor. Top view.

inductance of the leads needs to be paralleled, but the total capacity still needs to be up in the hundreds of pF.

The collector return bypass did not show this effect as strongly. Only about 2% gain was obtained by the use of a second parallel capacitor. Of course it was installed, because 2% here and 2% there all add up. Retuning the collector is advisable after each such change.

UHF, with coils and boughten capacitors. Now we get to a transition region again, where even those tiny 1/8 x 1/8 capacitors begin to fall down.

Figure 4 shows a UHF amplifier for 432 MHz using a coil and variable capacitor, (see Fig. 7) and regular bypass capacitors, that is, capacitors you can buy retail, with leads on them. Success with an oscillator and a diode receiver using a coil and variable capacitor made me wonder about using them in an amplifier, so back to the bench I went and I'm glad I did; it worked fine. Figure 4 shows the result. As usual a copper-clad baseboard 1¾ wide x 3¾ in. long that fits into a minibox formed the base of this little UHF firecracker.

Collector circuit. Nothing to this one. A brass angle strap to hold the Johnson type "M" model No. 160-102, 1.5 to 5 pF, five plate variable capacitor, was soldered to the baseboard as in Fig. 4 and Fig. 5. Next L1, a three turn coil, yes, even at 432 MHz a coil, was mounted as in Fig. 5, side view.

The KMC S5 H104 was then connected, collector to the coil L1, emitter to rf ground through C3A9 (later C3B), and the base to R3, a 1K resistor, tenth watt. An additional

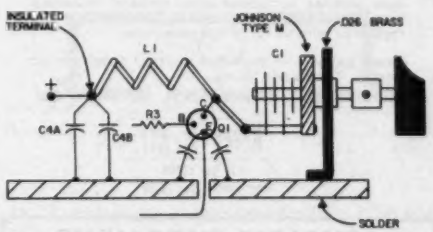

Fig. 5. 432 MHz amplifier using coil and capacitor tuning. Side view, layout of rf components.

ground strap of soft thin copper was soldered from the ground tab of C1 to the baseboard. The input jack J1 was soldered directly to trimmer C2, and J2 was soldered to the output cable matching trimmer C4.

The dc base bias resistors R1 and R2 were connected to the plus and minus battery lead pins, and R3 from the base to the center point.

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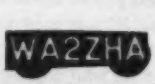

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Limiting resistor R4 was connected between the emitter and R5, a temporary 1K pot for adjustment purposes, which will probably be fastened later on the front panel of the minibox, or replaced by a fixed value.

C4A and C4B, some of those little High-K jobs I've been talking about, were wired between the low rf end of L1 and the baseboard, and the amplifier was about ready to go, for a comparison with the "Super-strapline" unit.

It fired right up. I had to reduce L1 from four to three turns, add on C3B and C4B and a couple more bypass capacitors C5 and

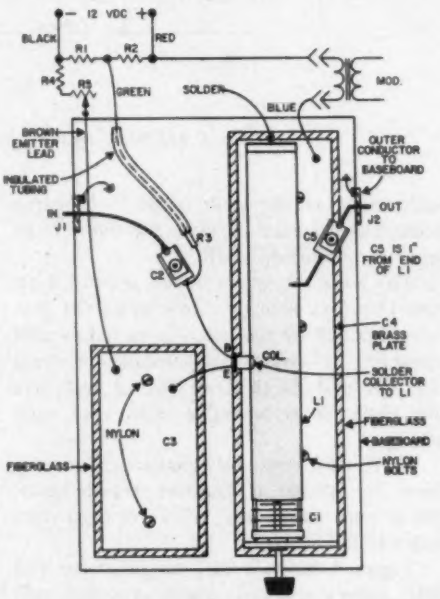


Fig. 6. "Super strapline" 432 MHz amplifier. Top view.

C6 on the terminal strip, and away she went on 432 MHz for an 18 mW output from the doubling type crystal controlled exciter. It also takes 20 mA of current nicely.

Special circuit notes on the use of the additional bypasses. C3B, in parallel with C3A on the emitter, brought the gain up some 4%. The same treatment at the collector return with C4B increased the amplifier gain by about 2%. Don't ignore all these little one or two percents. They can add up

to a large increase in gain, stability, and other goodies.

Comparing several times with the strapline unit, the output of this coil job seems to be only about 10 to 15 percent less. In view of this I hardly know what to advise you. If you like the very best, and have the time and plenty of nylon hardware and fiber glass sheet around, make up the strapline job. If you want to make up the quickest and easiest, build the coil job. They both work well and both have dc isolation on the box and cables, thus being compatible with other units, and are ready for modulating also (they both modulated just fine).

UHf with strapline and no dc on the box or cables. All details are given here because this one surprised me by being the best 432

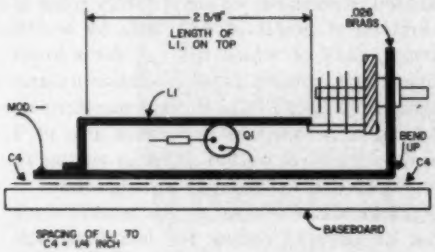


Fig. 7. "Super strapline" 432 MHz amplifier. Side view.

amplifier I've built so far, and it took quite a bit of time to plan, design, and make up the several models. The final circuit is shown in Fig. 6 and it's a dandy. It appears to have over 20 dB of gain and also still fits inside one of those little 2 x 4 in. miniboxes.

Here is how it works and gets rid of the dc on the box and cables. Figure 7 shows the side view of the collector circuit and the bypass capacitor which runs the full length of the baseboard and is then bent up to hold the tuning capacitor C1. This brass plate capacitor serves two purposes; it is the bottom half, or ground plane for the collector circuit strap on the top, and on the bottom side it forms a good solid rf ground capacitor along its whole length, with the five mil fiber glass sheet for dielectric. In this manner it serves also to couple the outer conductor or sheath of the output jack J1 firmly to the collector ground plane *without* making dc contact with it. And that's important if you want eventually to run the whole station from *one* battery.

The second brass plate capacitor C3 is connected to the emitter and serves to ground it firmly rf-wise through the fiber glass and the ground plane and over to the collector return strap, where it has *no* rf on it and is 180 degrees out of phase with the collector, as it should be for an amplifier. Remember that voltage is relative, and that phase is simply the time relation of one event to another. At one instant (rf-wise) the collector is positive and sees a negative emitter. At the next half cycle the collector is negative and sees a positive emitter. During all this time the emitter should stay still with no rf on it. It will be this way if you make Cc and Ce correctly, as shown. At the same time Ce acts as the connector from the emitter, through the groundplane-baseboard, over to the outer conductor side of J1, again without making any dc contact. So both Cc and Ce serve as double-purpose capacitors, and this is at 432 MHz I might remind you. As a matter of fact, after I had built the final model and tuned it up on 432 and had it working, I started to check the dc device voltages and found the meter wouldn't work. Why? Because there wasn't

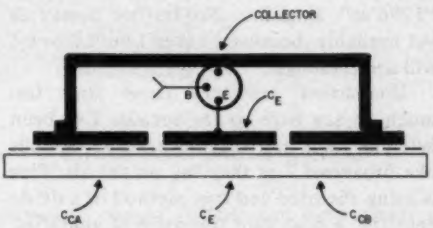


Fig. 8. Proposed half-wave line amplifier, 1296 and 2300 MHz.

any dc on the baseboard or cables. I had to go into Ce and Cc before I got to the dc. Of course there are no dc connections to the ground plane, but it was surprising at first.

You may or may not need this much dc isolation, but there it is. You can connect the negative battery terminal to the baseboard or not, as you wish.

Finishing with the circuit, the base input is untuned but is somewhat matched to the cable by C2, which you will find very useful.

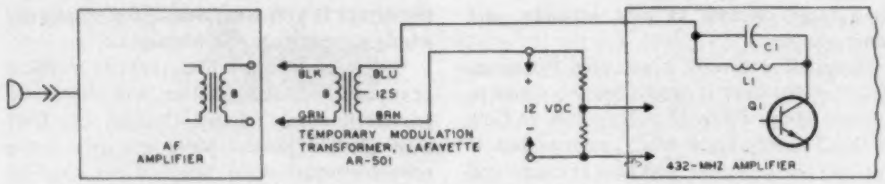


Fig. 9. Modulation test. 432 MHz.

This particular amplifier is intended to be driven by just a few millwatts from a crystal controlled exciter, so the base has considerable dc bias on it. If it is used as a second stage amplifier with more drive you may operate it without any dc bias other than the positive swing of each input cycle, and some charge on C2, the base input coupling capacitor.

The output capacitor C3, along with its position on L1, matches the output cable to L1, and you will also find this one very useful, as it varies the working output load on L1.

I find something like 20 mW output from this amplifier for about 1 mW input, which is enough from today's $5 device at 432 MHz.

1296 MHz and up. Figure 8 shows the proposed dc isolated collector circuit for the "1296'er" amplifier. No further details as yet available, because I haven't built it yet. I will soon, though!

Modulation voltages. There isn't too much to say here so far because I've been listening to it and the modulation "sounds like broadcast," as they say on the air. This is using the tried and true method of a diode detector, a high gain transistor af amplifier, and a pair of well-padded earphones. This keeps the sound of your own voice from reaching your ears through the air which would drown out the desired voice channel which for this test should come through the microphone, modulator, modulated rf power amplifier, and over through the air to the diode receiver, af amplifier and headphones.

Figure 9 shows the modulation hookup which is very straightforward as it was planned to be when the rf amplifiers were designed. Note the dc isolation available between the two windings of the modulation transformer. This is good because the modulator secondary has to be connected to the plus battery terminal.

The Lafayette AR-501 has an 8Ω secondary which connects to the 8Ω speaker output winding of the modulator. This modulator is a temporary one because when the proper modulation transformer is installed the two transformers will not be needed. Remember we are probably going to climb in rf power at 432 MHz by several stages, each of which will call for a lower impedance winding on the modulation transformer, so it is handy to have transformers with several values of impedance around. I also have a three watt af amplifier waiting to modulate that extra power coming soon.

There are also now on the market some ten or twenty watters for less than $20 which will make good modulators for some real power. That real power on UHF will also cost you real dough so save your pennies if you insist on it. Personally I'm just going to drive up Mt. Monadnock, 2000 plus feet of elevation, which I can see out of the window as I'm writing. I am of course interested in more power and am pestering the semiconductor lads all the time to divert or otherwise make available to us amateurs some devices for a watt or two at UHF at a price that we can afford. Maybe some mass market will do it for us.

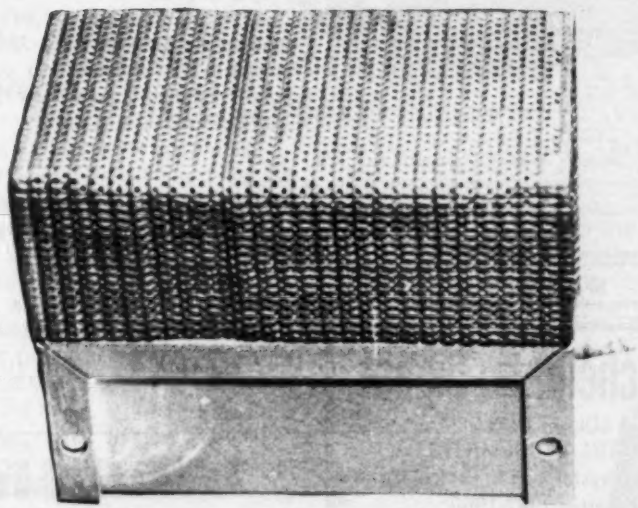
Winding up the modulation story, there is also the business of modulating one or more driver stages ahead of the final. This will lower the modulating impedance seen by the modulator still further. But that's all right because the lower the impedance the lower the cost of the transformer. You can get ten watt transistor modulation transformers for less than $5 retail right now. After all, there's not much copper wire in them.

"CQ, CQ, any station on 432 . . ."

. . .K1CLL

Bob Johnston W9WBH
236 N. Lincoln St.
Westmont IL 60559

LITTLE BILL



Overall view of the little transmitter with the homemade shield in place.

In these days of rising costs on practically everything, it is indeed a pleasure to construct and operate an efficient piece of radio equipment for pennies, and that is the reason for "Little Bill."

Circuit Description

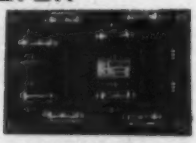
The rf section of the transmitter, which consists of a crystal controlled Motorola HEP 53 oscillator followed by an RCA 2N4427 rf power amplifier running class C, develops about 1.25 watts output at 28 MHz.

The oscillator stage is a Colpitts type, providing excellent frequency stability with respect to supply voltage and temperature and delivers over 100 milliwatts to the input of the rf amplifier stage.

The power amplifier stage uses a class C common emitter configuration and is modulated through the collector circuit.

A pi-network is used in the output resonant circuit to provide a measure of harmonic suppresssion, and the photographs show a double pi-network which was later changed to a single pi. A Drake lo-pass filter is used for additional harmonic suppression,

CW FILTER



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INDIVIDUAL STAGE Q: 4 (minimizes ringing)
IMPEDANCE LEVELS: No impedance matching required
POWER REQUIRED: CWF-2 . . . 6 volts (2 ma.) to 30 volts (8 ma.); CWF-2BX . . . standard 9 volt transistor radio battery
DIMENSIONS: CWF-2 . . . 2"x3" PC board. CWF-2BX . . . 4"x3 1/4"x2 3/16" (black wrinkle steel top, white aluminum bottom, rubber feet)

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as solid state finals are noted for putting out many harmonics of quite healthy levels.

Other types of transistors may be substituted for the particular ones used here, but remember that the final amplifier impedance might be different. This would have to be taken into consideration for modulator impedance matching purposes.

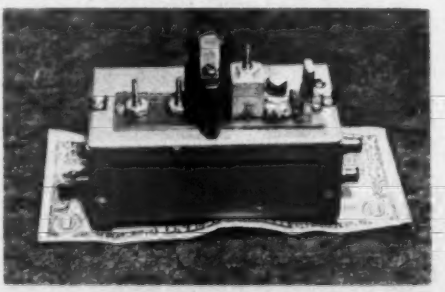
The modulator section starts out with a FET microphone amplifier (HEP 801) to obtain a high impedance input for the crystal microphone used. The output stage is a HEP 593, a 1W output IC having an 8Ω output impedance.

Other audio amplifiers may be used here, such as the Amperex TAA-300, and these IC modules are preferred to standard audio boards for their compactness that lends itself readily to miniaturization.

The output of the audio stage is fed to an 8Ω input modulation transformer that steps this up to the required modulating impedance, being about 75Ω in my particular case.

I wound my own modulation transformer according to formulas given in the Handbook. If an output transformer is available with a primary impedance of 75–80Ω and a secondary of 8Ω this can be used reverse connected.

If you elect to wind your own transformer, then a few words are in order here to assure good modulation results.



Top view of transmitter with shield cover removed to show general layout of components. Finned heatsink on final transistor is home made from aluminum sheet and painted flat black. Stand off supports small strip of plastic to hold heatsink in place and keeps transistor from being damaged if jarred accidentally. Crystal oscillator on right with its coil mounted in an old i-f can and amplifier on left with pi-network. Note small spring clips to hold shield cover in place on each end of mini-box.

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Be sure that the core that you use to wind this transformer has enough iron in it so that the core cannot saturate during modulation, and also that there is ample space for the windings. I mention this because the wire sizes used for transistor modulation transformers are larger than for comparable tube devices due to the current demands of the transistor and thus needs more room on the bobbin.

I used an old 5W output transformer and wound 70 turns of No.26 enamelled wire for the 8Ω primary and about 210 turns of the same size wire for the 75Ω secondary.

The final in my particular unit draws about 180 mA. The supply voltage is regulated at 13.5V so my final impedance is about 75Ω (collector voltage divided by collector current). The transmitter runs about 2W input and readily delivers 1W plus output.

With this modulation system, reports have been excellent. Running such low power you need good modulation for dependable contacts. This probably seems like much ado about modulation, but even when the signals dropped to S-zero on someone's meter the report was still Q-5 and that is what really counts. Incidentally, the microphone used here is one of the imported lapel types and cost only 67¢.

Construction

This little transmitter was constructed in a small mini-box measuring approximately 10 x 5 x 4 cm, and a top cover was fabricated from an aluminum front grill from an old transistor receiver, with the sides folded to form a shield and the seams were epoxy cemented and when dry the corners were filed smooth and then given a coat of metallic green spray paint for a pleasing appearance.

The ends of the box are used for mounting the receptacles for the dc power input and microphone and the rf output to the antenna. Two phone jack types are used for microphone and power input and a bnc type

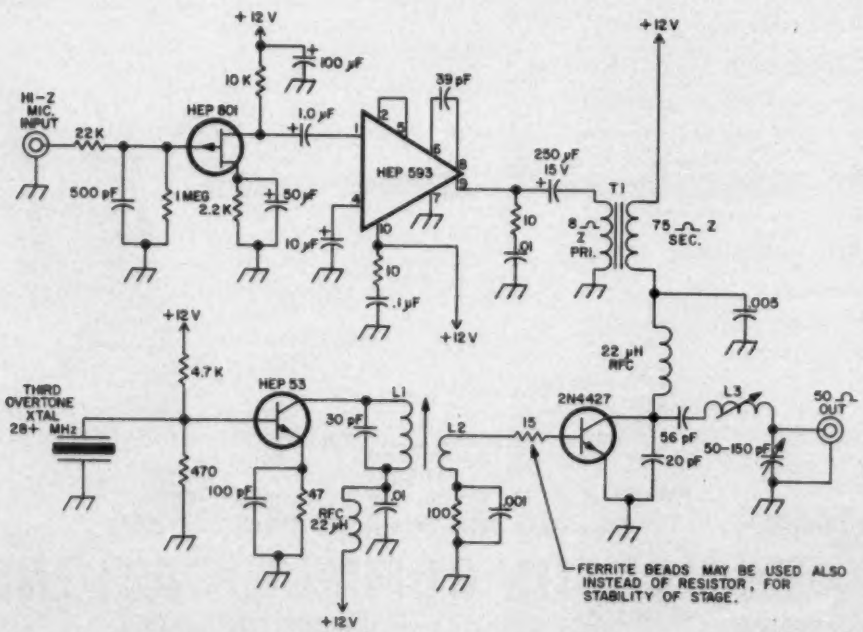


Fig. 1. Schematic of "Little Bill" transmitter. L1 - 13 turns No.28 P.E. CW, L2 = 2 turns link on cold end, L3 = 13 turns No.28 P.E. C.W.. All coils close wound on 6 mm diameter slug-tuned ceramic forms.

connector is used for the antenna to readily accommodate coax cable.

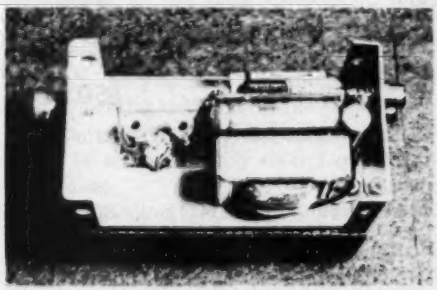
I made two small clips to hold the shield cover in place from scrap pieces of phosphor bronze stock strips, and these not only keep the cover in place but serve as grounding connections for the cover helping to keep harmonic energy from flowing out on the coax and creating unnecessary interference.

The coil forms used were ceramic surplus, just over 6 mm in diameter and tuned with a powdered iron slug. All coils were close wound with No.28 enamelled wire and given a coat of clear household cement.

Tuning Up

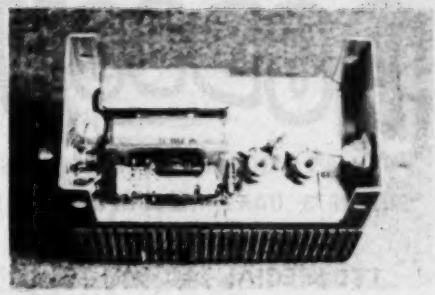
The tune up procedure is very simple and there should be no difficulty in obtaining proper output providing that all parts are good and the circuit has been wired correctly.

Connect some sort of dummy load to the transmitter output, such as a 51Ω resistor (carbon) and a diode and voltmeter, or use a QRP wattmeter as I do.



Bottom view of transmitter showing mounting of audio board and modulation transformer. Capacitor at extreme right near power connector is 100 µF unit across power input used to provide good filtering and low impedance when batteries are used. Parts layout is not critical here but try to keep audio stages away from final rf stage as much as posible to avoid rf pick up.

Starting with the oscillator slug and with power applied adjust the slug with an alignment tool for output indication on the meter and turn the circuit on and off several times to make sure there is reliable starting of the oscillator each time. Then adjust the amplifier slugs and the pi-network capacitor for maximum output. Be sure to use heatsinks on the rf amplifier. I also use one on the audio amplifier in the interests of cool operation and efficiency.



Bottom view of transmitter showing parts placement. Note antenna connector on left apron to allow very short lead to pi-network. Photo shows double pi-network originally used but later revised to single pi output, see text. Modulator components shown on right side with board containing all audio parts except transformer which is fastened to box directly.

For the final touch-up in the alignment procedure, install the lo-pass filter in the line from transmitter to the dummy load and repeak all stages for maximum. The harmonic content will now be the lowest level and will not influence the output reading.

Transistor output stages are not as tolerant of high standing wave ratios as tube circuits, so be sure that your SWR is kept to a low level at all times.

Results

On the air results were most gratifying. I used a variety of antennas and modulation reports were very good indeed.

Using a ¼λ whip attached to the side of the house about fifty to sixty contacts were made from both coasts and Canada with reports ranging from S-zero to S-9 plus. Always noted was Q-5 copy, attesting to the modulation capability.

With a 2-element beam, South American contacts were made as well as Central America and even the Windward Islands on a CQ!

It has been a real pleasure to operate this little unit. I should like to express my sincere thanks to Sam W9BDM for his patience during all the tests that were made, and for his incessant nagging to make the modulation as good as it now is.

...W9WBH

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The described 3000V power supply incorporates rugged design specifications coupled with generous dimensions that provides versatility in accommodating transformers and related components found on the surplus market.

Construction

The high voltage power supply shown was easily constructed, as all mechanical work can be performed with a metal munching tool, pop rivet gun, good soldering gun, and ordinary hand tools. An electric drill with variable speed control will save much time.

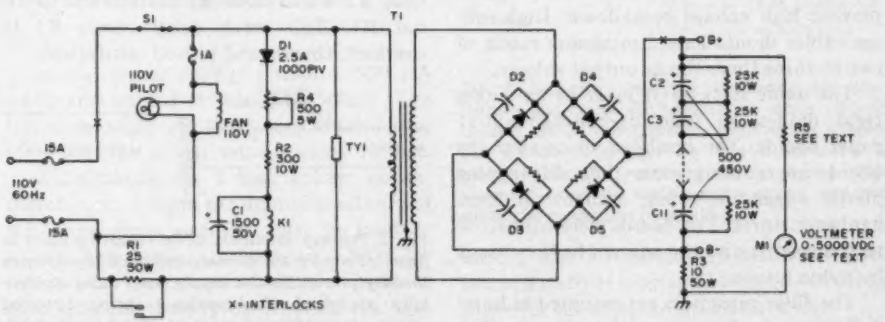

Fig. 1. Schematic of the 3000V power supply. The diode stacks D2–D5 are constructed of 8–2.5A 1000 PIV series connected diodes each. Shunted across each diode is a 470K 1W resistor and a .01 1000V disc capacitor. C2–C11 should be 500 µF with a minimum voltage rating of 450V dc. K1 is a P&B type PR3DY, 24V dc coil with 25 amp contacts. T1 has a 2200V rms secondary with a 500 mA minimum rating. The thyrector is a G.E. 6R520SP4B4.

The main aluminum chassis and front are 33.02cm x 43.18cm x 7.62cm (standard) and the back aluminum wall has a 2 cm inside lip at the top and bottom for attachment to the main chassis and cover. The front chassis and rear wall are attached to the main chassis by generous use of pop rivets. The main chassis is reinforced on the bottom with a thick steel plate with one caster at each corner and one in the middle to support the weight. The line cord is fed to the rear through a steel conduit.

The cover is manufactured by hand bending a sheet of aluminum to tightly fit the chassis assembly and is held in place by sheet metal screws. Right angle aluminum brackets were installed on the back plate along the sides to accommodate the fastening of the cover. Air is exhausted by mounting home air vent assemblies on the sides of the cover. The local lumber yard had the vents.

Before attaching aluminum to aluminum I roughed each contact surface with fine sand paper to assure a good electrical connection. I also connected each chassis and the back together electrically with copper braid.

The front of the supply contains a voltmeter, on-off switch and pilot light. The rear of the supply is designed with safety in mind. The B+ and B– connections are in a minibox with two grometted holes in the bottom. The large insulated feed-through was fitted on a small plexiglass sheet and the hole in the aluminum made extra large to prevent high voltage breakdown. High voltage cables should have a minimum rating of two to three times the dc output voltage.

The diode stacks were made by mounting eight diodes on four pre-punched epoxy paper boards. The insulated spacers for the boards are nothing more than self-tapping plastic expansion tubes, available at most hardware stores. The boards were connected to the spacers and the spacers to the chassis by nylon screws.

The filter capacitors are mounted in holes drilled in plexiglass with a hole saw. The hole was too small to begin with, requiring some filing. The plexiglass is held in place by self-tapping plastic expansion tubes and nylon screws. To prevent the capacitors from arcing to the chassis the area below the capacitors has a sheet of punched epoxy paper board cemented to it – also the cut-out plastic circles were cemented to the bottom of each capacitor.

To keep air circulating a small fan was mounted in the rear of the supply. The fan is fused and the fuse is located in the front under chassis where it can be changed without removing the cover. The ac line is terminated in the front chassis at the switch and at this point the thyrector is also located across the line.

Located at the lower right of the rear chassis is a heavy duty ground connector *which should always be utilized for maximum safety.*

All lettering was accomplished by the application of white dry transfers over black wrinkle paint.

Circuit

The circuit utilizes a full wave bridge rectifier circuit with a capacitor filter of 50 μF. This provides approximately 5% regulation with a 3 KΩ load. Ten 500 μF, 450V capacitors provide a total voltage rating of 4500V.

The high voltage diodes, capacitors, and transformer are protected from excessive current when the power supply is first turned on by a series limiting resistor R1. The time delay for relay pickup is determined by R4, which adjusts the time required for C1 to charge and energize the relay K1 which closes its contacts and shorts out R1. Too much delay causes R1 to overheat. One second proved satisfactory.

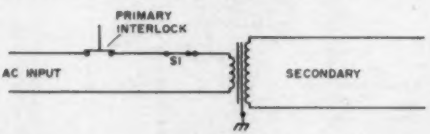

Fig. 2. Primary interlock. When removing cover or panel of supply the primary interlock should open thereby preventing the supply from being accidentally energized. A homebrew spring operated switch or commercial pressure switch works well. The primary interlock must have ample current carrying capability.

The supply also incorporates a voltmeter that measures the output voltage. An inex-

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pensive meter can be utilized as the supply incorporates a resistor multiplier string to increase the range of the basic meter movement, *but never use a meter with a metal zero adjusting screw in high voltage circuits!* To choose the correct value of R5 for your meter, use the following formula:

$$R5 = \frac{\text{full scale desired}}{\text{meter reading in amps}}$$

In my power supply I used a 500 μA meter and wanted to read it to 5000V. The full scale value of .0005 was divided into 5000 and the solved value equaled 10 MΩ.

A resistor is not a high voltage device; therefore to achieve the desired resistance of R5 many series resistors must be used to handle the voltage. I used 10 1MΩ, 1W resistors in series, mounted on a strip of epoxy board, thereby distributing the voltage equally across ten resistors. The epoxy board was mounted to the front chassis on two ceramic insulators.

Before final soldering of my multiplier string, I substituted 1 MΩ resistors as needed until I had a measured 10 MΩ total resistance. The total resistance must be 10 MΩ in order for the meter to read accurately.

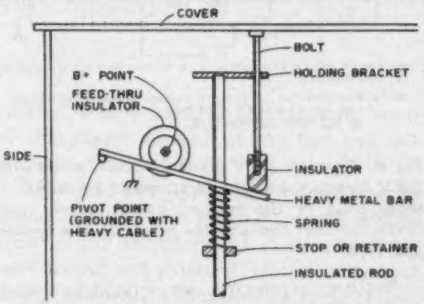


Fig. 3. Secondary interlock. Removing the cover permits the metal shorting bar to move up and contact the B+ point, thereby shorting any dangerous voltage to ground. As long as the cover is removed the B+ point will be grounded. This assembly must be mechanically strong and not subject to movement or bending.

To protect the supply diodes from transients a thyrector-diode assembly is installed at the line input. Also, each side of the line is fused to provide adequate protection to the supply and station line circuits.

Interlocks

All high voltage power supplies should contain an interlock or interlocks. Basically there are two types: the primary interlock and the secondary interlock.

The primary interlock is similar to the power cord assembly on a television receiver. When you remove the back of the set you open the ac line and the television cannot be energized by unauthorized personnel without a special line cord. See Fig. 2.

The secondary interlock (Fig. 3) normally shorts the secondary out thereby discharging any residual charge on the high voltage capacitor string, thereby also protecting the amateur from electrical shock due to an open bleeder or equalization resistor.

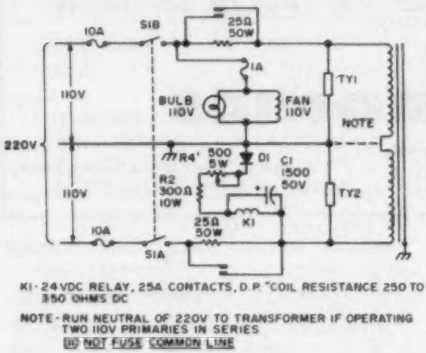


Fig. 4. Alternate 220V primary circuit for use with 220V transformers. The components are similar to those used in the original circuit except two thyrectors are used and the relay K1 is a double pole type.

Neither a primary nor secondary interlock alone will give 100% protection, but utilization of both in one supply will come close.

In essence, in respect to safety, it can be said that a power supply that does not break down requires minimum service – therefore the best protection is to build high voltage supplies with generously designed safety factors.

Transformers

This supply can accept transformers with a secondary voltage of up to 2500V rms with no design changes. A 2500V rms secondary will give an unloaded output of 3500V dc. Even at this dc level there is an ample power supply design safety factor. For a transformer with a 220V primary, see Fig. 4 for wiring details.

Testing

When the circuit was completed I checked the wiring and looked for any possible short circuits. Between ground and any positive voltage points I looked for a minimum of 3 cm separation when the insulation was solely air.

I also inspected each electrolytic capacitor to make sure none of the exhaust ports were obstructed by construction. A defective electrolytic or an electrolytic with a plugged or blocked exhaust port can explode violently.

Before energizing the circuit I reviewed the basic rules of safety.

1. Never bypass an interlock.
2. Fuse the circuit properly.
3. Never operate or test the supply with the cover removed or high voltage terminal exposed.
4. Make sure others in the household are aware of the location and operation of the master power cut-off switch so they can disconnect circuit from line in an emergency.
5. Label *all* high voltage points and equipment as such: DANGER – HIGH VOLTAGE."
6. Voltmeter should read zero and main ac line should be disconnected before removing cover or changing high voltage leads.
7. Make sure the family members know the basics of artificial respiration. Many shock victims die of suffocation before professional help arrives.
8. If you don't understand something, get the facts before proceeding.
9. Properly connect the power supply to a good and permanent earth ground.

Even when the circuit has been inspected and rules followed, there is the potential danger of defective new or used components. I cannot overemphasize that a 3000V dc supply with a 50 μF filter is a lethal device. Always assume that *all* points in a circuit of this type are dangerous and proceed with that in mind.

...K8VIR

J. K. Bach WB2PAP
Ivy Hill Road
Walden NY 12586

DIAGRAMS

Do you have problems reading a schematic? Here are some obvious and not so obvious hints on how to do it . . .

If you know some fundamentals and are willing to learn a few conventions, reading circuit diagrams is as easy as pie. You can look at a fairly complex print and say, "From what you have told me, the trouble is here!" and point to a certain component. In a few cases you can't be wrong, and generally it will turn out that you are right if you use care and don't back yourself into a corner.

Back when radio was *wireless*, the connections were shown by a drawing that was photographic in character. If you had an antenna (aerial) and a lead-in and a ground rod and a 2-slide tuner and a crystal detector and a bypass condenser and a pair of headphones, you just drew these things as much like they actually appeared as you possibly could (Fig. 1).

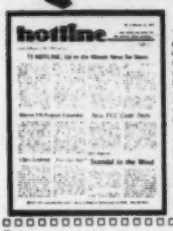
Soon it became apparent that the supporting trees were irrelevant, and that the drawings were uselessly detailed. Down through the years a kind of shorthand evolved which depicted the etherial "soul" of the gadget instead of the fins and tailfeathers.

This was not imposed by some international authority, but evolved through natural growth, and therefore the development has been sound and practical. Occasionally even now a magazine will introduce some innovation in an attempt to outstand their rivals. If it is clear, and helps, everyone will take it up. If it is in the least confusing they get plaintive and abusive letters until they desist and reform.

It is the same with typefaces; they all differ slightly, but they're all clear and easy to read. But you don't, as a rule, examine printing with a magnifying glass. And you just as seldom examine a good print for style and makeup – you are far more interested in what it says.

Figure 2 can be taken in at a glance by any experienced radioman. A is the antenna (the trees are not indicated). G is ground, L

HOT NEWS! for hams...



The premier issue of the 73 HOTLINE, which will be published every other Friday, is scheduled for April 5th. This newsletter will cover all the up-to-the-minute happenings in amateur radio . . . FCC news . . . new petitions filed . . . new actions . . . DXpeditions . . . new products . . . propagation flashes . . . Hotline Classified ads . . . job opportunities in the ham field . . . hamfest and convention news . . . contest news . . . all those things hams want right now and not the usual two months late magazine schedule. The 73 HOTLINE will be chock full of last minute news since it will be in the mail just a few hours after deadline closing.

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is the 2-slide tuner. It is just a coil of wire with two sliding contacts on it – the picture doesn't show this too clearly but the diagram does. D is the detector, now called simply a diode. C is the bypass capacitor and the two connected circles are the headset – and doesn't it *look* like one!

But if you have a little background experience, the diagram implies even more than it says. The left-hand slider on L is in series with the antenna, and tunes the set. This slider is adjusted first, usually. The right-hand slider is a step-down auto-transformer arrangement to match the diode impedance which is fairly low; this slider peaks up the signal a little. With only a diode and no amplification whatever, the volume is also low, even with a "good" antenna, 60 ft or more, as high as you can get it. Also, a lightning-switch is a prudent part of the antenna system, all implied in A. As against the low level, this crystal receiver had a startling clarity and lack of distortion that largely made up for the rather faint signal. For some applications it remains a practical circuit to this day. You never need batteries for it.

Later, radio magazines began to diagram transmitters backwards, with the antenna on the left just as it is in the receiver diagram in Fig. 2. To trace the signal path from the master oscillator through amplifiers and harmonic generators, you read from right to left. The receivers were still read from left to right, from the antenna to the loudspeaker or headphones. As the brotherhood became more sophisticated and did more signal tracing, they howled about this just before WWII and now all radio diagrams are scanned from left to right, just as you would read a line of printing.

Figure 3 is a simple example of a transmitter. The X is the Piezo crystal that determines the frequency. Oscillations here are amplified in the triode tube and passed on to the tank circuit at the right; this tank comprises a tuning capacitor and a coil. The antenna lead is tapped on the coil for proper loading.

The triode tube shows a grounded cathode, and a plate element at the top, with the control grid between them. A battery and a telegraph key are also shown. Simple as it is, hams have sent thousands of miles with just such transmitters. Now notice one thing – here it is *assumed* that you know that the

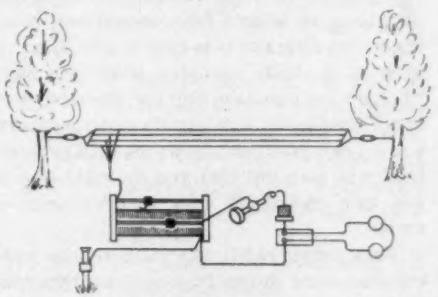

Fig. 1.

cathode must be heated for the tube to operate. The heater circuit, which could be a battery with an on-off switch in one lead is often implied but not shown. The plate circuit plus and minus terminals could be connected to a battery for portable work, but in practice is far more likely to take some kind of power pack: ac supply, transformer with a high-voltage winding, rectifier,

filter, and a low-voltage heater winding for the tube heater. You could use a tetrode or pentode screen-grid tube if you wanted, just by adding a screen voltage supply through a resistor to the plate voltage. The rest of the circuit was essentially the same. I built just such a transmitter in the early 30's.

Figure 4 is a simple receiver. Notice that you still scan it from left to right, just as the signal goes. First the input tuner, then the tube – ah, regenerative, see the little tickler coil in the plate circuit? The regenerative feedback control is that variable capacitor connected from tickler to ground. Hmmm. Makes a very sm-o-o-o-th regeneration control. What's this? A filament-type tube, probably dry-cell operated. The text will say what it is – a 1E4G or a type 30 or 99, probably. Pretty vibration – sensitive, but okay if you don't jar the table. Very quiet and sensitive; no ac hum.

Of course any transmitter operating on any frequency in the same town will overload it, so this circuit is good only in isolated areas. Nowadays it usually doesn't make it as a receiver for serious work.

How could a beginner know all this? A beginner couldn't. But if he actually built either of these circuits, he could tell us many things about them not mentioned here. After he experimented with them a little, he'd no longer be a beginner. When he talked to more experienced hams about his problems, they would no longer have to explain their explanations; the conversation would be enjoyed by both parties.

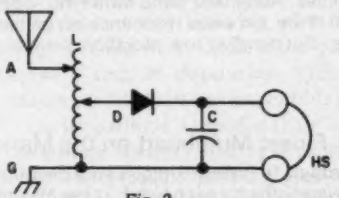

Fig. 2.

It is a curious thing that no one ever pointed out that circuits now follow the signal path, and are drawn from left to right.

Not all of us have visual imaginations, but technicians often do. Take a large complex circuit – a digital computer, a telephone carrier system, transmitter, receiver – and ask the expert a question about something near the beginning of the chain, something else near the middle, and a third thing near the end. The first he will answer before you finish asking. The second takes a pensive stare and a lengthy pause. The third requires time out for a cigarette.

It's actually funny to watch his mind work, because you can easily follow his line of thought if you know the network yourself. He does not necessarily trace the entire path of the signal; he considers groups and sections where this is possible. But in the main he starts at the beginning and follows the signal path at a good clip until he arrives at the point in question, and then, Bang! – your answer. The hesitation is for travel time to the point of interest; once there he can answer a clear question instantly.

Okay, we know that the signal path goes from left to right. But often there are dc potentials to consider, such as plate voltages.

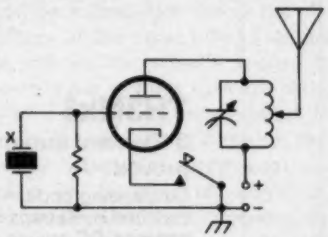

Fig. 3.

Here is another convention that has become a fairly rigid rule, and once again no one has ever mentioned it in print as far as I know. The highest plate voltage is indicated by a bus-bar drawn along the top of the drawing, and this voltage (+250?) drops through the plate load resistance (drawn vertically) to +125V at the plate terminal, down through the tube to maybe +10V at the cathode terminal, and the rest of the way down to zero at the ground bus through the cathode-bias resistor. The whole business is shown more or less vertically. When it isn't, when the plate bus is shown at the bottom with leads going up to the tube, it becomes noticeably more confusing and hard to read.

The vertical potential-concept is particularly helpful in the case of voltage dividers – you just look to see where the voltage tap is, and you know instantly whether it is higher or lower than some other tap.

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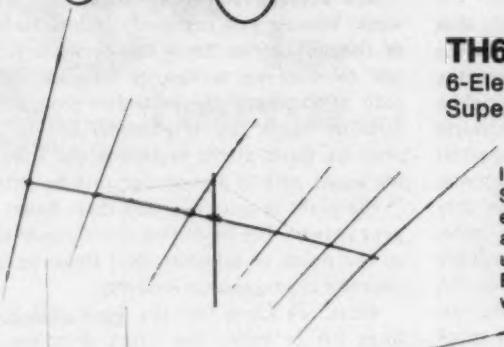

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Figure 5 shows the now-forgotten Loftin-White audio amplifier circuit. It is a direct-coupled, wide-band audio amplifier with a high gain. It did require a power pack with about twice the normal voltage output since the two tubes are essentially in series for dc.

When this circuit first appeared, it was invariably drawn with the big voltage-divider resistances (its main feature) shown horizontally, and many of us built them by-the-numbers without really knowing what we were doing. But see how much more plain and obvious a vertical disposition, such as Fig. 6, makes it! The tetrode (or pentode) at the left has its cathode tapped a little way up on the voltage divider, making it slightly positive for the proper operating grid bias (the grid will be correspondingly negative, class A, low distortion.) The screen grid of the input tube is at much higher potential, around 100V. The plate of the tube 1 is connected directly the the grid terminal of tube 2, the output tube.

This is the whole point; what this circuit is all about. It does away with frequency-limiting coupling condensers (capacitors) and transformers, but places a very high positive voltage from tube 2 grid to ground. If the cathode of the output tube were at ground potential or anywhere near it, the tube life would be measured in seconds. But

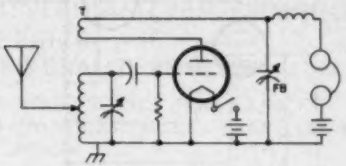

Fig. 4.

it isn't. Instead, it is tapped just under the plate/grid voltage tap for the two tubes, so that the cathode is a few volts more negative (less positive) than the plate/grid tap.

Isn't this wrong? It is certainly different from the input tube, number 1. But don't forget the voltage-drop across the plate load resistance of the input tube! This makes the plate/grid voltage actually applied to them somewhat *less* positive than the cathode tap of the output tube, never mind that the latter is tapped further down on the string. This one little point threw a lot of experimenters in the good old days! It would throw some now, but remember that in a voltage-divider you climb up the ladder and the voltage gets higher as you go. You know what dc voltages you need, so work them out.

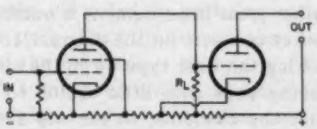

Fig. 5.

Power companies are little interested in circuit theory diagrams, so power diagrams are all but unintelligible to communications men. Their contacts look like capacitors to us, and the wires are a senseless tangle that goes to and from every which-way. But they know the conventions they use, as we do ours, and their diagrams give them the information they want. To each his own, and they can have it!

As the years went by, circuits became ever more complex. At first when we thought of an amplifier, we visualized tubes,

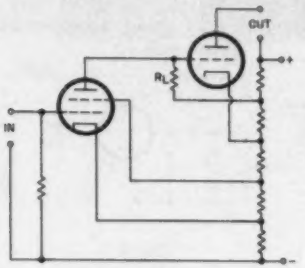

Fig. 6.

coupling transformers, filament rheostats and all the rest of the junk. The modern way is with block diagrams.

Nowdays, an amplifier is not a bunch of things, it is their total, an entity or thing in itself. We draw it as a triangle (to point direction) with the output from the apex. This amplifier (Fig. 7) may have vacuum tubes, transistors, or it may even be an integrated circuit full of microbic (wel' microscopic, then) amplifiers, diodes, stabilizers, and all sorts of esoteric stuff. You just accept it as such and such an amount of gain and let it go at that – there's plenty more to consider without dissecting the amplifier besides. If you want to know how to connect it, or the exact internal working, you look up the IC in the book.

Another great improvement is numbering tube-socket contacts on the diagram, to save you looking the tube type up in the manual and making your own little sketch to help you trace the elements. In the old days all tubes had four prongs, all were surface wired, and the filaments were always the thick pins 1 and 4, the grid was 3 and the plate 2. But Noval tube bases may be connected any way at all, depending on the particular type. So I'm grateful to the character who started numbering tube elements, bless his little heart.

Now let's pick a real dilly – a modern (more or less) transceiver. It has only one tuning control which acts as a variable frequency oscillator (vfo) to tune the receiver and the transmitter to the same frequency simultaneously.

Actually, the receiver is a quite conventional superheterodyne – you know how that works – and the vfo differs from the usual oscillator only in that it is more stable and better calibrated, we hope, than is usually the case. The antenna switch (Fig. 8) rests in the receive position. The rf amplifier in block diagrams is shown as a rectangular block rather than a triangle, because it gives more room for labeling. The rf amplifier goes to the converter or mixer, which also gets some high frequency from the vfo and the mixer output is 455 kHz for the i-f amplifier and so on. Tuning the rf amplifier? Good question – usually it is mechanically ganged with the vfo capacitor in usual fashion, but if the band to be covered is narrow, the rf need not be tuned at all. It is a lot broader than the oscillator tuning in any case.

The transmitter is a little more tricky. The band shown is the 80-meter or 3.5–4.0 MHz, so to mix with this band and produce 455 kHz for the i-f amplifier, the vfo tuning range must be offset 455 kHz one way or the other, i.e., 3.955 to 4.455 – fine for the receiver, but plenty no-good for the transmitter. Because most of this oscillator range is completely out of the band. In the receiver, we subtract the *signal* from the

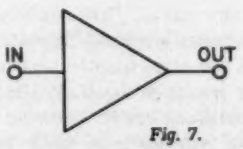

Fig. 7.

oscillator frequency to give 455 kHz which the i-f amplifier will accept. In the transmitter, we *subtract* 455 from the *oscillator* signal to get the proper transmitting frequency band, 3.5–4 MHz.

To make this a bit plainer, suppose you were receiving an AM signal on 3.950 MHz. This would mix with the vfo frequency tuned to 4.405 and the difference frequency, or lower sideband if you like, would be 455 kHz.

When you want to transmit – the vfo, still putting out its tuned 4.405 kHz mixes with 455 in the *transmitting* converter, and

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comes out the difference frequency of – surprise! – 3.950 kHz. This goes through a filter to eliminate other frequencies and harmonics and upper sideband and such like, is amplified, modulated with your voice and connected to the antenna by operation of the antenna switching relay. Thus, the transmitter itself is also a kind of superheterodyne, and in the case of SSB, the similarity between transmitter and receiver is still more striking.

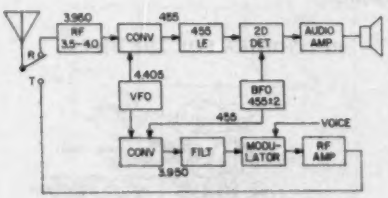


Fig. 8.

The British invented this thing in World War II, and we built one version for them, known as the "Tank Set" because it was used for communication between tanks. It had weird-looking dials with adjustable detents for pretuned settings, which dials had Russian characters on them for the benefit of our Eastern Allies, who used the sets, too. The set had an 807 in the output which loafed along with +350V or so on it. It also had a tank-to-tank high-frequency transmitter and receiver in it, a superregen deal which the hams on this side of the water promptly discarded to make room for the power pack. They discarded it on the other side of the water too – nobody ever said the British aren't good radiomen! The receiver is an excellent one, and is often used in the British Isles as a DX broadcast receiver. It is even used for hamming, where low power suffices.

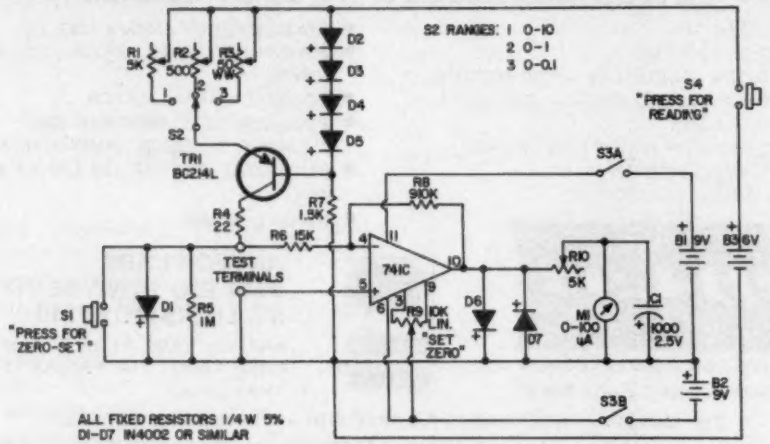
Transistor circuits follow the same lines as tube circuits as regards signal path and dc potentials. They have the benefit of tube experience to build on, and present no special difficulties as far as the diagrams are concerned. If you have a reasonable command of the fundamentals, you should now be able to read a diagram nearly as fluently as a comic strip!

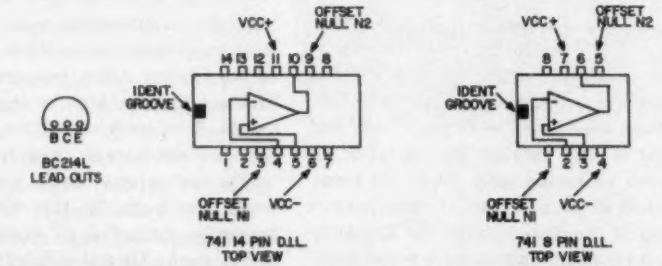
. . .WB2PAP

CIRCUITS, CIRCUITS, CIRCUITS...

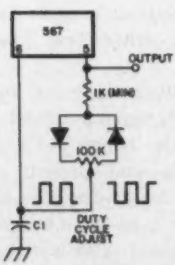
The following circuits have appeared in the referenced books, magazines, application notes, etc. While we try to reproduce all of the information that should be needed by an experienced constructor, readers may want to avail themselves of the original sources for peace of mind.

Readers are requested to pass along any interesting circuits that they discover in sources other than U.S. ham magazines. Circuits should be oriented toward amateur radio and experimentation rather than industrial or computer technology. Submit circuit with all parts values on it, a very brief explanation of the circuit and any additional parts information required, give the source and a note of permission to reprint from the copyright holder, if any, and the reward for a published circuit will be a choice of a 73 book. Send your circuits to 73 Circuits Page, 73 Magazine, Peterborough NH 03458.





Full circuit diagram for the ohmmeter. It is capable of measuring resistance down to less than 001Ω. The two circuit points marked 'A' are wired directly together.



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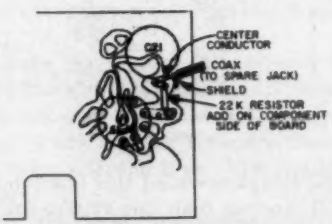
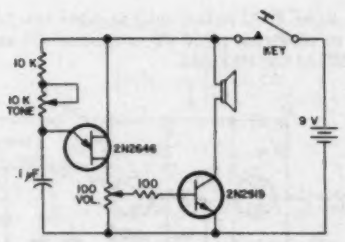
PATCHWORK FOR THE HW-101



MODULATOR CIRCUIT BOARD (Foil Side)

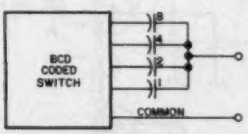
CB Channel Assignments

Channel Number	Frequency (MHz)	USE
1	26.965	Voice, same licensee only
2	26.975	As above
3	26.985	As above
Brown (24)	26.995	R/C & walkie-talkies
4	27.005	Voice, same licensee only
5	27.015	As above
6	27.025	As above
7	27.035	As above
Red (25)	27.045	R/C & walkie-talkies
8	27.055	Voice, same licensee only
9	27.065	Emergency use only
10	27.075	Voice, any CB licensee
11	27.085	As above
Orange (26)	27.095	R/C & walkie-talkies
12	27.105	Voice, any CB licensee
13	27.115	As above
14	27.125	As above
15	27.135	As above
Yellow (27)	27.145	R/C & walkie-talkies
16	27.155	Voice, same licensee only
17	27.165	As above
18	27.175	As above
19	27.185	As above
Green (28)	27.195	R/C & walkie-talkies
20	27.205	Voice, same licensee only
21	27.215	As above
22	27.225	As above
A	27.235	Business Radio Only (HELP?)
B	27.245	As above
23, Blue (C)	27.255	Voice, any CB license, also R/C & walkie-talkies, also Business Radio
D	27.265	Business Radio Only
E	27.272	As above



CODE PRACTICE OSCILLATOR

Here is a code practice oscillator with variable tone and volume. Thanks to WB9IDI for this circuit.



SIMPLE DECADE CAPACITANCE

Using a BCD coded switch capacitor in parallel can be switched in or out. Thus by using 4 capacitors any valve from 1 to 16 can be obtained, however since most BCD switches are from 0 to 10 a decade is obtained. Capacitors used are in the relation 1, 2, 4, 8 with the proper multiplier 1μf, 2μf, 4μf, 8μf. Keep all leads as short as possible. Thanks to L. S. Naguiney WA3GBC/1, for this circuit.

wanted

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RT-857/ARC-134 . . . RT-859/APX-72 .
RT-524/VRC . . . RT-246/VRC . . . . . .
R-442/VRC . . . R-390A/URR . . .
RT-648/ARC-94 . . . AN/TRC-68 . . . . .
AN/VRC-24 . . . AN/URC-9 . . .
CU-1669/AR . . . 490T-1 . . . 618T-1-2-3
C-6287/ARC-51BX . . . AN/PRC-25 . . .
AN/PRC-77 . . . Wilcox 807

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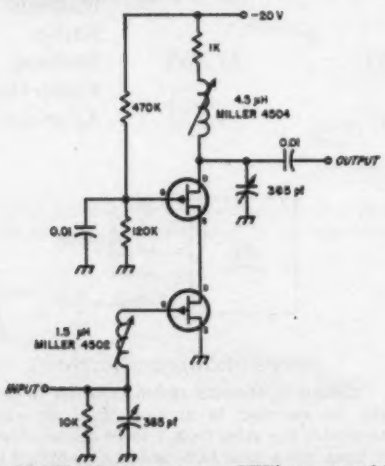
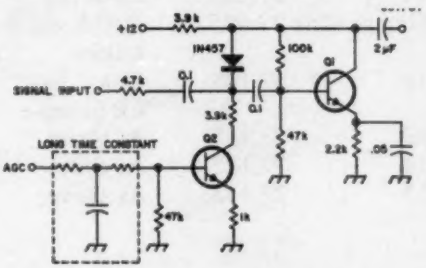
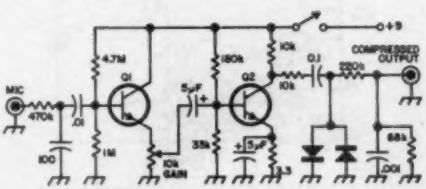
MORE CIRCUITS . . .



This 30 MHz if stage uses two FET's connected in the cascode arrangement to provide 20 dB gain without neutralization; the bandwidth is 4 MHz. Both FET's in this circuit are 2N3819, MPF105 or TIS34. With a negative supply voltage, the 2N4360 or TIM12 would be suitable.

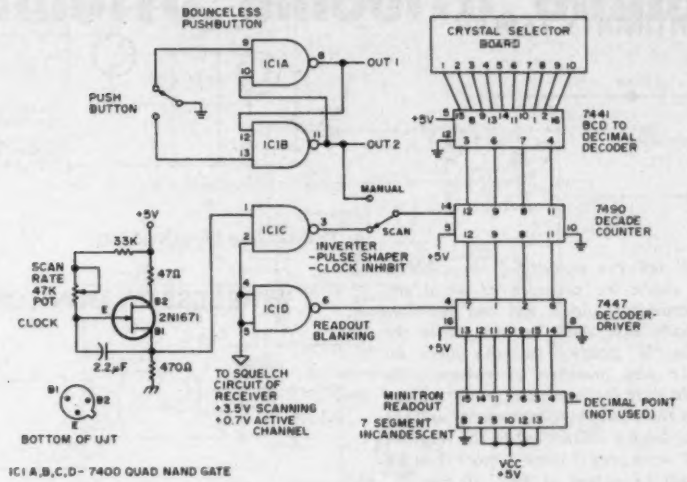


This super AGC circuit only requires two transistors to obtain up to 60 dB of control. Q1 and Q2 are 2N1613 or HEP-254.



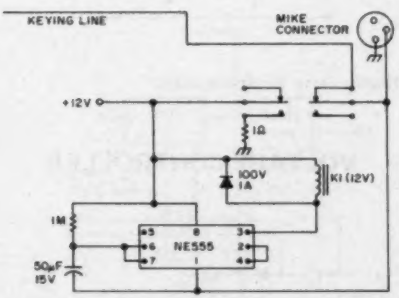
Two stage clipper/preamp will increase the talk power of your rig. Transistors Q1 and Q2 are 2N1304, 2N2926, 2N3391, SK3011, or HEP 54. The diodes are IN456 or HEP-158.

INTEGRATED CIRCUIT CHANNEL SCANNER



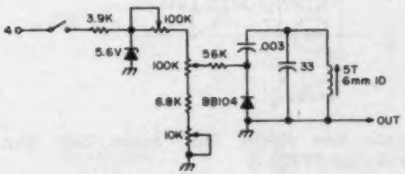
This unit is capable of scanning a series of channels in a receiver by switching crystals in and out of the first oscillator. It works like this. A UJT is used as a clock to produce a series of pulses. This particular UJT is fairly expensive ($2-$4) but it operates well on 5V. The pulses are of the wrong polarity and quite noisy. To correct both situations, they are fed into one gate of a quad two-input NAND gate, a 7400. The output of this gate is connected through a switch and thence to the counter. Note: Bypass 5V supply frequently .01-.1μF. Thank you George Cserenyi and Brian Hyndman VE7BHY.

ANTI-TIMEOUT TIMEOUT TIMER

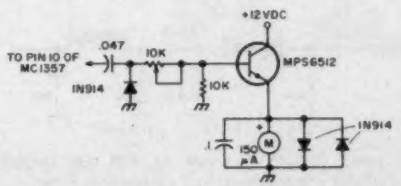


This circuit is designed to timeout your rig before it times out the repeater. It uses a simple 1 minute 59 second timer. It is shown wired for a TR22 but can easily be modified to work with any rig. Total cost about $5. From the 31/91 KaChunker.

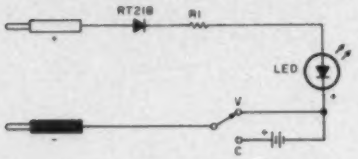
12 MHz VFO FOR A TR22



S-METER FOR REGENCY

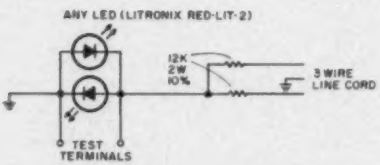


LED VOLTAGE AND CONTINUITY TESTER



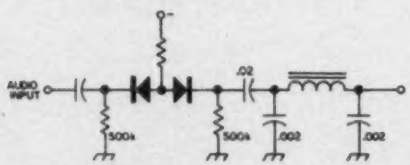
This tester will tell you polarity (+ or -, 6V or 12V). It will check for presence of dc at any terminal or connector and it will test the continuity of a bulb, fuse, cable or wire. When the switch is in the "V" position you can check for voltage polarity and presence of voltage. The ED150 will light only if the positive (red) test lead is connected to the positive voltage source and the negative (black) lead is connected to the negative terminal. It will work only if there is more than 3V present, and will be ruined at 15V. In the "C" position a 9V battery is added to the circuit. The ED150 will light when the test leads are connected to anything that will carry current provided that the "anything" is electrically OK. Parts needed are: R1 = 470Ω, ¼W, LED = Sprague ED 150 (or 155), diode = RT218, 9V battery, SPDT switch, miniature box, grommets, battery connector, two 3-terminal strips. Thanks from the Sprague Products Co., No. Adams MA 01247.

SUPER SIMPLE DIODE CHECKER



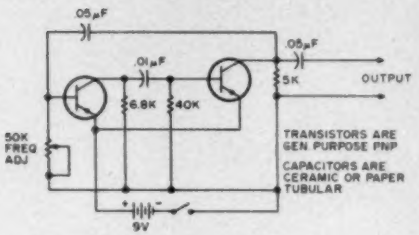
Thanks Noel Calvin, 2683 Buena Vista Way, Berkley CA 94708.

AM or FM CLIPPER



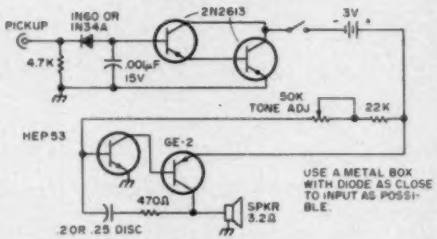
A good clipper for AM or FM use includes adjustable clipping level and a harmonic filter.

SIGNAL INJECTOR

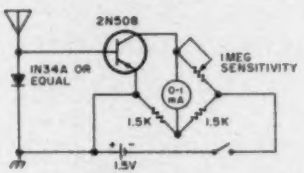


Thanks Steve Uhrig WA3SWS.

WIRELESS CW MONITOR

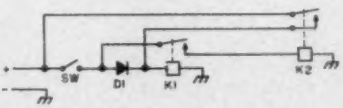


FIELD STRENGTH METER



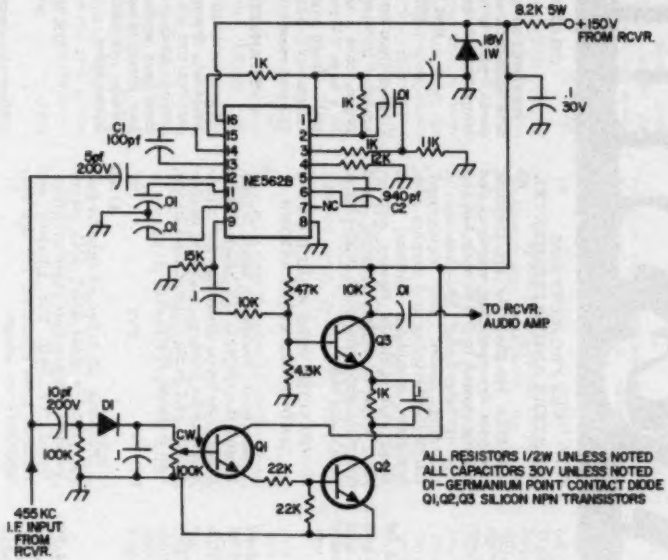
Thanks Steve Uhrig WA3SWS.

VOLTAGE CONTROLLER

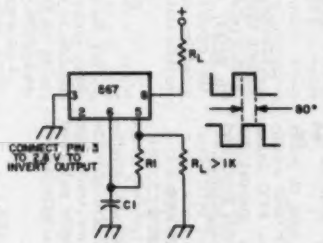


K1 on first and off last. K2 on last and off first. Handy for Pentode or Tetrode power amplifiers where K1 controls plate volts and K2 controls screen volts – overload dekeying, etc. Thanks W8UFN.

CIRCUITS, CIRCUITS, CIRCUITS...

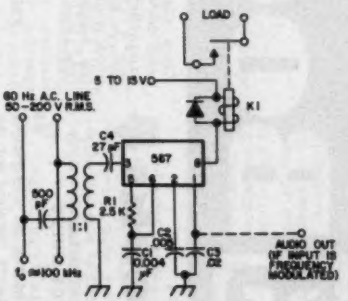


OSCILLATOR WITH QUADRATURE OUTPUT



Courtesy of Signetics Catalogue.

CARRIER CURRENT REMOTE CONTROL or INTERCOM



Courtesy of Signetics Catalogue.

... Staff

73 Books & Stuff

the Books

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the Stuff

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Dress up the shack with this award for 2-way Slow Scan Television communications with 10 countries. Endorsement provisions for separate bands.

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An unusual certificate — get one and keep your mate happy. An award to those who have the good fortune of having an understanding partner who appreciates all good things about amateur radio (staying up all night, spending money for rigs, etc.).

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This is an assortment of twelve different back issues of 73 from the years 1960 through 1964. Normally these back issues would cost you $1 or more each, but since this assortment is our choice instead of yours you benefit with a big bargain. Here is a good way to build up your technical library with hundreds of interesting and valuable technical articles and construction projects.

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still bringing you only tubes. At this price you get our choice of back issues. This is an excellent way to fill in missing back issues, if you like to gamble.

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These wall sized maps show the states and call area. They are specially designed for coloring to show your progress toward the Worked All States award of ARRL or the Worked Almost All States award put out by 73 (for proof of contact with 49 states). Since you will probably be wanting to work for the award on several bands you will want several maps. They come in groups of four.

WORLD DX MAP **$2**

This is the same wall-sized DX map that is included with the DX Handbook except it comes to you rolled up instead of folded. This is so you can put it on the wall or have it framed. The map is designed with all country prefixes indicated and space for you to color in the countries as you work them. Visitors can see immediately how much of the world you have contacted! The zones are on the map as well as prefixes. Maybe you need several maps.

CUSTOMIZED DX BEARING CHART **$4**

An amateur who works for a big computer company has a program which permits him to plug in your location and have it print out the bearings of all the countries of the world from your shack. Once you have this list you will use it for every DX contact. The chart gives the bearing and distance to all major cities and countries. Be patient when you order for these have to be run through in groups so that we can offer them to you at such a low cost.

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73 DUZZ

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☐We have managed to hold our subscription rates at a reasonable level despite a host of rising costs: postage rates (our nemesis, due to go up again), staff salaries (itinerant apple pickers are making more every year and the chimpanzees are asking for more and more bananas), rising printing costs and increased costs in just about everything else.

WHAT WE GIVE YOU:

☐More articles on every facet of amateur radio than any other publication.

☐We're usually a couple of steps ahead of our competitors in publishing articles you want to read about.

☐More ads than any other Ham magazine– that means you can keep up on what's new in your hobby.

☐NEWS PAGES: Read about how hams are aiding people during times of crisis. Read our special interest columns which will keep you up on what's new in your facet of ham radio – contests – SSTV – 50 MHz – Solid State – and more, more, more!

MORE

☐An open forum for you in our letters to the editor column. Here you can sound off on your likes and dislikes (about us or anyone else). We publish both sides.

☐Wayne's Editorials – never boring, sometimes controversial. They're a great conversation starter at ham clubs and on the air.

☐IRS Report: Does an average ham pay more in taxes than a multi-million dollar company? Find out how the IRS is out to screw you and what you can do about it.

FOR YOU!

NAME _____ CALL _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

☐ Sign me up for a money-saving 1-year subscription for $7.
☐ Here's my $12 to rip you off for a 2-year subscription.
☐ YEAH! I'm mean enough to sign up for a 3-year subscription for $15.
☐ BankAmericard ☐ MasterCharge Account No. _____ Expires _____
☐ Check enclosed
☐ Bill Me Signature _____

Schematic Of The Month

WILSON

2m FM Transceiver

The basic circuit of the Wilson transceiver has evolved from the Ken unit a year ago to the Henry Tempo FMH – and now it is the Wilson. But there are changes – substantial changes – and all for the better. The Ken was a lot of transceiver for its price, but some amateurs wanted a hotter receiver and wanted a little more poop in the output. The Wilson has a new front end and it is a hot one. It also has a better rear end for more poop on transmit.

There are some other benefits to this rig when compared with other HT's on the market – things like the netting capacitors on all of the crystals, both transmit and recieve. This makes it a lot easier to get the unit right on channel. And all of the crystals are plugged in too, not just some. The earlier Ken units had two channels soldered in – which was not serious where you had a use for both 34/94 and 94/94 – but these days, with no 34/94 repeater in New York, Chicago, Washington, Boston, Los Angeles, etc., that turned out to be a rather serious wasted channel. And in the 34/94 areas, the 94/94 pair wasn't all that valuable. Better that all crystals can be plugged in as in the Wilson. The fact is that a five channel HT with two soldered in channels is a three channel radio.

The Wilson has six channels – and that is none too many in most areas. It is none too few either, for seldom are you inan area where you can reach more than six repeaters with an HT. Considering the size of the HT – and there is more than a little resistance to the larger HT's such as the Unimetrix – more than six channels would begin to crowd things inside so the unit would have to be bigger. You want a unit that is comfortable to hold in the hand – that will fit in the pocket – or on the belt.

Speaking of holding in the hand – one of the really annoying things about most HT's is that if you have any kind of noise level you have to hold the speaker up to your ear and then quickly swing the HT down to speak in the loudspeaker when it is your time to transmit. This little maneuver usually takes longer than the time between transmissions on the repeater, so you are aced out. With some ops you have to be mighty fast of finger to break in and that part of a second it takes you to swing the HT from your ear to your mouth you'll lose out. The Wilson has thymike mounted toward the bottom of the unit, right where your mouth comes when you put the speaker to your ear.

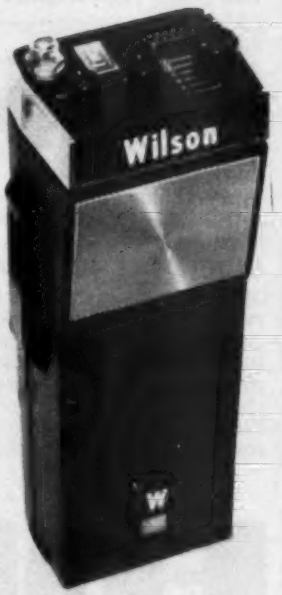
The use of the separate mike (such as you'll find on the late Motorola HT's) results in considerably better audio. You'll find that reports are most gratifying on your audio.

Another big hassle with the Motorola units are those incredibly expensive nicad battery packs they use. The Wilson uses those low cost AA size nicads (you can put in regular AA flashlight batteries in an emergency) – these batteries sell at every Radio Shack or Lafayette store for peanuts – or you can even catch someone like Hal Babylon (advertised in 73) with surplus nicads for a fraction of the Radio Shack price!

When you use your HT on your belt – for instance at hamfests – you want a remot mike that plus into the unit. The Wilson has a plug for this – and it also feeds out the audio fro the loudspeaker which you can hear from a small speaker which is mounted right in the mike case!

The S-meter is handy when you are in a weak signal area and want to peak up a repeater in order to be sure to get the best signal back into it. It doubles as a battery indicator so you won't run your nicads down too far and reverse them. Nicads don't like that.

The circuit board for the Wilson is the size of the case – and this means that everything is easy to get at for servicing. If you've ever tried to fix a Motorola HT-220 you will appreciate the room in the Wilson for work –

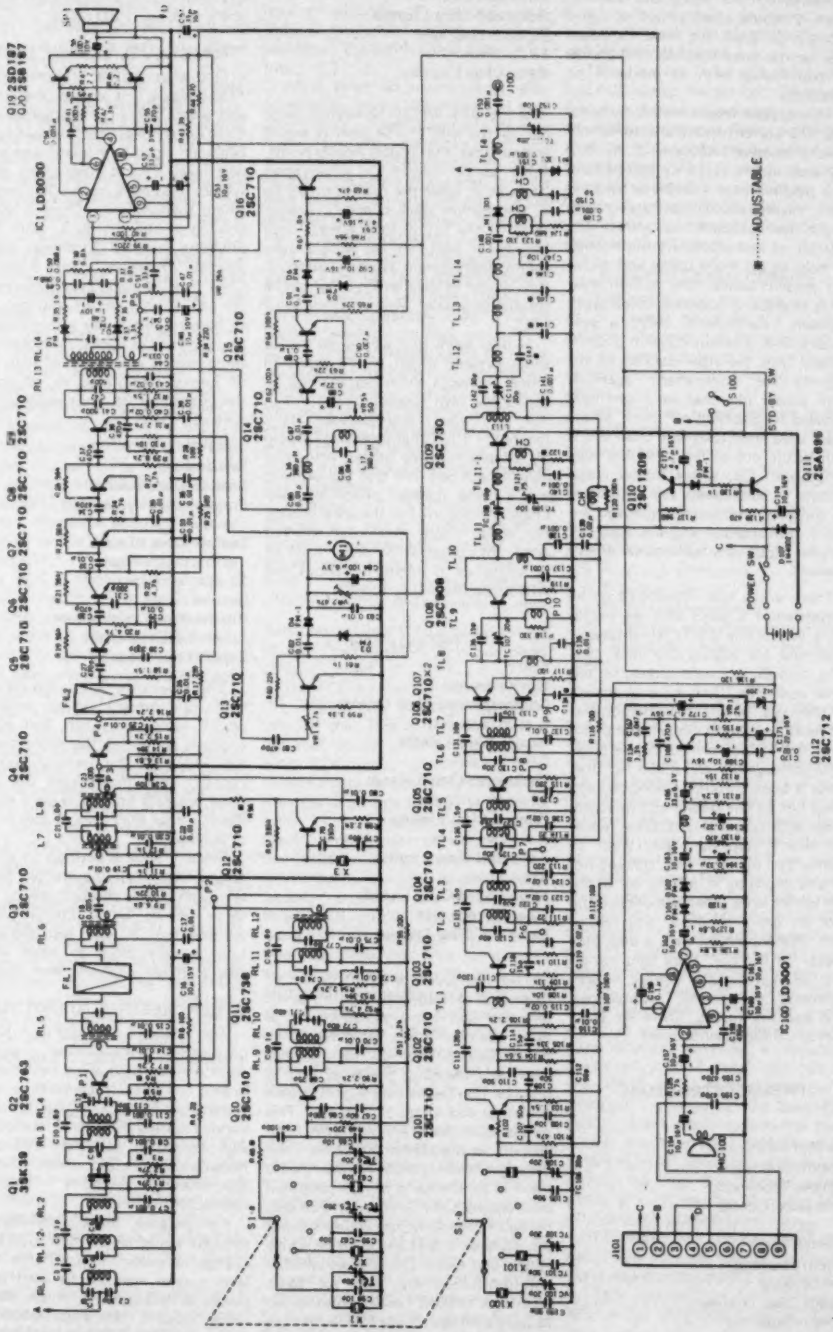


and the use of small, but not invisible parts.

One problem with the earlier Ken units was a weakness of the internal molded track for the battery pack – it often broke when the HT was dropped – and who doesn't drop one now and then? The Wilson may break if you try hard enough, but it will take an incredible beating before giving up.

Obviously the Wilson is quite a rig – and one would expect it to come through at around $280 or so. Wilson is selling them for only $199 for reasons best known to themselves. It would seem prudent to get one of these radios before the folks at Wilson wise up.

...STAFF


ADJUSTABLE
POWER SW
STD BY SW
IC1 LD3030
IC101 LD3001

(W2NSD/1 cont. from p. 3)

Form 1 would require the applicant to write out his name and address. Form 2 would require him to sign a promise to learn the code someday. The license would permit him to use all ham bands with all modes – no subbands.

This system would have some benefits. The current trend toward extinction of amateur radio via a 3-½% drop per year would certainly be reversed. It is possible that it might be substantially reversed and that the growth might be sufficient to attract the interest of manufacturers big enough to help us get more bands and widen our present bands. One million amateurs pressuring congress could work wonders, particularly with a well funded EIA amateur division pouring money into the right pockets in the appropriate government agencies. With power like that we might look forward to grabbing off some of the lesser used UHF television channels. It is difficult not to see what has happened with CB, where totally illegal activity is enthusiastically supported by industry and permitted to go virtually unrestrained by the FCC, all because there are millions of dollars involved.

There are a few drawbacks to be considered. I suspect that we would see a lot of the W2OY syndrome – remember his calling CQ first class only, no lids, no space cadets, no ten meter ops? The CBers have an answer for this, too, as they have demonstrated recently when a woman complained to the FCC about CB interference. They got together and killed her dog, threw a brick through a window, and called her on the phone and threatened her with rape and mutilation. When this didn't stop her, they went to beating her up on a bus, stealing her car and smashing it, hitting her in the face with a brick when she opened the door to get a telegram, and ten or more obscene phone calls a day, plus threats on her life. They sent her all sorts of merchandise collect – sent plumbers, electricians, ambulances, taxis and fire trucks. There *are* ways to keep CB complaints down.

PRESENT STRUCTURE

Usual Entry
5 wpm code test
General/Tech exam
Tech Class License
or
Usual Entry
5 wpm code test
Novice exam
Novice Class License
13 wpm code test
General exam
General Class License
Advanced exam
Advanced Class License
20 wpm code test
Extra exam
Extra Class License

Since 95% of the amateurs never get to the end of the line, it would appear that the system leaves something to be desired. It is anyone's guess as to what the results would be if the system were changed. Predictions of the future have always been chancy at best, so we should take claims that certain changes in structure would be disasterous or would be greatly beneficial with a truckload of salt.

It does seem as if we should try for some system which would result in more amateurs achieving the top license. My own suggestions on this in the past have been almost totally ignored – I felt that incentives should be offered – while others, who were able to win out, felt that punishment was a better method of forcing compliance. The carrot or the stick choice. My ideas might not have worked either, of course, so perhaps I can't be as smug as I might be about the ARRL plan failing so totally.

THE CQ PLAN

Entry
Novice exam
Communicator Class License
5 wpm code test
Novice Class License
General exam
Technician Class License
13 wpm code test
General Class License
Advanced exam
Advanced Class License
Extra exam
Extra Phone Class License
20 wpm code test
Extra CW Class License

This has seven different classes of license, presumably with seven different sub band allocations. It is not clear why more Techs would go on to General than do now, so that may be misleading chartwise and in practice the Tech ticket would remain the dead end street it is today. This means that there are just two basic changes to the present structure – the communicator license – this would seem to be the same thing I proposed as a Hobby Class license for 220 use, though I have some reservations about the scheme – and the separate Extra Phone and Extra CW licenses which I also petitioned the FCC for some years ago. It didn't make sense to me to have a 20 wpm code test to operate phone – and there seems to be general agreement about this. I do appreciate CQ adopting my petitions and pushing them as the new CQ plan.

THREE LEVEL LICENSE SYSTEM

One plan that is attractive to the FCC because it is simpler than the six and seven level license schemes is the three level idea which would have a beginner, an intermediate and an expert level. This is a bit closer to the system used back in the 30's and 40's where there was the Class A with all privileges, the Class B with fewer privileges, and the Bootlegger with no official privileges. The Bootlegger Class had the advantage of no exams, the call of your choice, and the use of all bands – obviously a forerunner of the current CB operating system. For those readers who have had their sense of humor amputated or attrophied, the preceding was not seriously presented.

Entry
Novice exam
Learner Class License
Endorsement by licensed amateur for code
Learner Class License with CW privileges
13 wpm code test
General exam
Intermediate Class License
Advanced/Extra exam
Expert Class License

This obviously isn't a lot different from our present system either. It would lump the Tech and Novice together and either the Advanced and the Extra or the General and Advanced. They might keep the Extra Class separate and let it die a natural death, rather than demote Extras back to Advanced.

Since I have a petition in already asking that Techs be granted Novice privileges, and another asking that there be an Extra Phone License without that 20 wpm test, this structure is very close to what would emerge if my petitions were granted.

OTHER RESTRUCTURING IDEAS

The FCC is up against a lot of decisions in restructuring – such as what emissions to allow each class of license – what frequencies – what transmitter power – eligibility for the various station licenses – station call sign format – call sign prefixes – honorariums for old timers – volunteer examiner eligibility – length of license terms – etc.

For instance, there is considerable thought being given to a substantial change in power limits. If the three level system were to be used and a power differentiation of six dB between powers, this might allow the Learner to use 125 watts, the Inter-

mediate 500 watts and the Expert 2000 watts output. Yep, that's output, not dc input or PEP input. Our 1 kW limit has been around for a long time and it may be time to take a closer look at it.

In my travels I have found that there are definite advantages to running high power, no matter how avid the QRPers may be. When you operate from YA, VU, 9N and other remote areas like that you hear the high power boys almost nightly – the medium power boys a few times a month – and the low power boys a few times a year. The lack of a substantial number of high power signals invites commercial invasion of our bands.

Time was when a kilowatt was so prohibitively expensive that only the most wealthy amateurs could afford to build one. Now you can tuck a kilowatt into a car – almost under the dash! It used to take racks (six feet each) of equipment for a rig like that, and now you can carry it around and set it on the table. CBers have shown us that 3000 watt transmitters are not all that expensive to buy or use. Shouldn't we be able to work out as well as CBers?

The FCC is about ready to throw out all previous restrictions on call signs and are thinking in terms of things like W1A for some club stations – which would be a 1x1 call. They would keep the present 1x2 (W1AW) and 1x3 (W2NSD). Add to that possible 2x1 such as WA1A and 2x2 like WA2AA, plus the current 2x3 calls. This would give some nice privileges for incentives. They are also thinking in terms of more prefixes, and the U.S. has many we haven't been using. They might open up the AA-AL, KA-KZ, NA-NZ and WA-WZ. What turns you on?

With such a wide selection of call signs available the FCC could set up their computer to give you the call of your choice. How about that?

There is much, much more to be said on restructuring, so let's think about it and we'll have more next month. In the meanwhile, if you come up with any ideas that seem inspired, why not send them in for exposure in 73?

FCC VS NETS

The complaints of some of the amateur nets – in particular the Wescars net – complete with pressures via Congress – about interference from jammers has the FCC seriously concerned. Wescars and the jammers have their own version of the mideast conflict.

There is no question that some of our nets do serve very valuable purposes, at least some of the time. They do tend to give us better use of our frequencies since they keep large numbers of stations all on one single channel instead of spread out all up and down the band. Other nets are for fun.

While there are undoubtedly amateurs with severe psychological problems who are just looking for people having fun that they can spoil and who delight in clobbering a net, many of the problems encountered by nets have more to do with the way the net gets started on a channel. Few amateurs take well to the flat demand that they get off a frequency because it is the net's and the net is going to start in a few minutes. I will never forget the day I was operating from PJ3CC, happily working fellows around the states, when a woman came on channel and told me to get off the channel – that I had no right to be there – this was the YL International SSB Net frequency and the net was about to start and I certainly was a trouble maker for even daring to use the channel. Wow!

Amateurs who feel that the interference to a net is serious enough to warrant a complaint to the FCC should keep in mind that there is a petition on file now by K6BX to officially license and regulate all nets. Every complainer should be sentenced to read this petition -- he would never complain again.

The FCC position is that first of all the regulations prohibit deliberate interference. This is probably one of the least heeded rules on the books – every DX pileup is testimony that dozens to hundreds of amateurs are intentionally interfering with each other – but maybe pileups don't count? Frequencies are supposed to be available on a first-come first-served basis – and this is supposed to include nets, even if they are registered with the ARRL and are thus "official" nets, whatever that means. The FCC feels that it is up to amateurs to work out a solution to the net problem – or else they will do it. And all we have to do is remember the recent "solution" to the repeater problem to know that the chances are good that the very worst solution to the problem is FCC action.

If the FCC continues to get complaints about or from nets, it is quite possible that some system of net licensing, with one to two year delays, license fees, and allocated channels and times, with the usual delays in changes in times or channels, might be established. This prospect – and again I suggest you get a copy of the K6BX petition and read the complete thing (I think copies of it can be had for $20 each or perhaps a bit less). This prospect should help nets do some self-examing to see if there isn't some way to solve their problems with public relations – better techniques of getting the net started, etc.

There is a lot to be said for leaving the FCC alone. Remember, when you feel that there is something you want to do that is not specifically permitted that the FCC works on the other side of the coin – if it is not prohibited, then it obviously is permitted. The basic rule when dealing with the FCC – and all government – is, when in question, don't ask.

NEW FCC EXAMS COMING

The Commission has been working on an update of all of the amateur radio exams and it is being helped in this by some amateurs who are expert in the fields to be covered by the exams.

The material to be covered in the exams has been broken down to the following categories:

1. Rules and regulations
2. Radio phenomena
3. Operating procedures
4. Emission characteristics
5. Electrical principles
6. Practical circuits
7. Circuit components
8. Antennas and transmission lines
9. Radio & communication practices

It will be a while before the new exams are ready for use. The study material will not be substantially different from that which appears in the 73 license study series. The main changes that the new exams and study material will bring about will be a complete revising of the ARRL license study manual, which will be made obsolete. Some feel that it is just about irrelevant right now, but it does sell well and is responsible for helping thousands of prospective amateurs to pass the present license exams – and helping thousands of others to fail.

The 73 Magazine license study guides have been broken down pretty much as the FCC has done it, with each chapter covering a technical aspect of radio in depth and not, as the ARRL manual does, just giving questions and answers. The benefit of this in depth study system has been proven lately by the high percentage of successes of amateurs using the 73 system on the Conditional exam, which is a lot tougher than the FCC administered General exam now.

The recent FCC figures show that about 50% of those taking the Conditional exam are passing it as compared to 75% passing the General exam! What is the difference between them? Well, they cover about the same

material, but the General exam is the usual multiple choice exam with five statements, four of them wrong, and you have to pick out the correct answer. On the Conditional there are four right answers and one wrong — you pick out the wrong. It's a lot harder.

STRIKE

A strike of most of the unions at the printers of 73 Magazine delayed the mailing of the June issue by about ten days. This issue (July) might possibly have been delayed too. If so, then we apologize for a situation beyond our control.

WOODEN CIRCUIT BOARDS

A recent phone call from K3CMZ, who builds a lot of stuff but doesn't write much, explained some short cuts he has developed which may be of interest. For instance, he uses some of that thin balsawood for mounting ICs — you carefully shove the IC pins through the wood and you're in business. The balsawood makes a light servicable chassis. He makes little boxes for gadgets out of those brass strips they sell in hobby shops (where he went for the balsawood). The strips come to an inch wide and are 12" long, cost 25¢. He cuts these up and solders them to make small brass boxes. A small strip of hard wood along each side of a box, routed out to slide the balsawood chassis in, and you can stack up a number of the little chassis in one box.

VISITING BOSTON?

FM'ers visiting Boston may wonder which are the best repeaters to be ready to use. There are a couple of dozen repeaters in and around the Boston vicinity, but not all of them are close enough for low powered rigs, and a few are not friendly to visitors sad to say.

For starters you should be ready for 146.04-64, the Waltham group. This is the busiest repeater in greater Boston, and one of the most friendly (when you can get through to it). If you're toward the north end of town, from Route 128 on out, you'll do well to be set for 146.25-85, the Derry New Hampshire club. You won't find a more friendly group anywhere in the country. If you prefer a more businesslike and get off the pot machine, one which handles a lot of patches, you'll want 146.22-82 in Weston, one of the vast complex of MMRA repeaters.

If you have the weird crystals or a Clegg 27B, you'll be able to say hello on one of the most sophisticated repeaters in the area on 146.39-99. This is W1UQ, a closed repeater, but peopled by friendly and interesting ops.

A new repeater in Malden is on 146.19-79. You may get in a contact or two on it if you can get K1VTE to stop playing with his autopatch. In the same town you can also use WR1AAA 146.31-91. This is a strictly local repeater and will take you from downtown Boston out to about Route 128 (the highway which circles Boston. Say hello to Mel W1BHD.

Up on the north shore is WR1AAC on 146.28-88. It is also a local repeater and not too strong even in Boston. Out in Billerica at the Honeywell plant is WR1ABP on 147.72-12. It isn't as active as a lot of the others, and watch out for a zing from Lew, but there are a lot of first rate fellows that do hang out there. The 147.84-24 repeater covers that northern area pretty well too, but they generally don't seem to like visitors and have been known to turn off the repeater if you try to call in.

Off to the west of town you'll run into a repeater on 146.01-61 — not too active, but a nice group. There is also one on the ridiculous pair of 147.87-03, but it is kind of closed, and very inactive. If you can get them to talk with you, the fellows are fun to meet. Ask them about W1PRI and then stand back for the blast! It's almost worth the trouble of waking them up. If you have crystals for 146.07-67 you can exercise them out that way too. Out Worcester way you can call in on 146.37-97 and say hello to Charlie. Same pair works north out of Salem (NH), but not used a lot. Very nice guys when they are available. Also to the west is DL2AA/WR1, the only reciprocal licensed repeater.

That should hold you in and around Boston.

REPEATER WARS

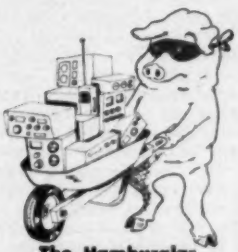
The FCC has been quite outspoken on one point: if we cannot solve our own problems they will try to solve them for us. I think we have all had far more than we need of FCC solutions to ham problems and from the exciting experiences we have had we should learn that it is time to stop turning to the Great White Father for help whenever we get into trouble — and realize that we must work out our own problems.

Repeater wars are problems and they need solutions — better solutions than higher and higher power — deliberate interference — kerchunking — and the usual silliness. I remember the reaction of a repeater owner in Holyoke MA, when Ken Sessions first put a repeater on 34/94 up here in New Hampshire — RTTY on the input by the hour. War. Not a visit to see what could be done to solve the problem.

With difficulty I will restrain myself from giving specifics, using a certain cretin in Connecticut as a horrible example of the war-prone repeater op.

In most areas we have an excellent start toward peace with the organization of repeater councils and frequency coordinating groups. But that is just the first step. One thing that became very clear during the FM forum at Dayton was that there is a serious need for some way to get repeater councils together to solve intermural problems. Whether this will turn out to be a national council meeting or a council newsletter remains to be seen. Communications is badly needed at this level.

W2NSD



The Hamburglar

STRIKES AGAIN!

List from Past Issues:

Mfr., Model, Ser. No.	Owner	Issue
AF98 No. 10988	K5LKL	1/73
PM98 No. 10918		
M1070 pwr supply		
Trio TR2200 No. 241980	WA2ZBV	1/73
Clegg 22er No. 1900-578	W1DHP	2/73
Standard 826M, No. 112007	WA8PCG	3/73
FM270 No. 27013-1141	W2LNI	4/73
FM-144-10L No. F459	WA8WOA	4/73
NPC 107m pwr supply		
2, SAJ-1PL Omni Gen., No. 327885		
HR-2 No. 04-02879	W8GSR	6/73
SB-34 No. 21 1828		
STD 826 No. 011268	WA2FSD	6/73
HT220 No. GJ7327	State Univ. of NY (Albany)	6/73
Yaesu FT-101	W4GF	7/73
No. 8203 12279/CW		
HR-2 No. 0302030		
Clegg 27B No. 72013-1068	W3BXL	7/73
STD. 826 MA No. 208078	WB2OEW	7/73
Drake ML-2 No. 10582	W3MSN	8/73
Sonar FR-2526 No. 21-4250	Doherty	12/73
STD SRC-861-SH No. 9725		
STD SRC-707C No. 2833		
TPL PA 6 IDE No. 1092		
RP MEA 22 No. 212		
Two Larsen antennas		
Swan 270 No. M-252616	W4NTB	12/73
STD SRC 148A No. 208570	W7DKB	12/73
Marker Luxury No. 2256	W7BVP/8	2/74
Regency HR-2A 2m FM No. 04-05632	WB8NSU	3/74
Collins Model KWM-2 No. 13651	W9JS	3/74
Regency HR-2A No. 04-0767	WA3TVI	4/74
Kenwood TS-520 No. 6400902	W7JFR	5/74
CW 526/5115 filter Issue EC-20 No. 1161	W1PVF	7/74
I-RF Communications RF 453-2 VHF FM XCUR No. 1277	K3YHR	7/74
Sonar 3601 No. 1418	K1UXD	7/74
EBE Model SR-144 No. 46316 $25 reward $25 for information for arrest and conviction of thief	K4KVF/5	7/74
Clegg 27B No. 27103-2891	WA1ECF	7/74

Caveat Emptor?

Price – $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor . . .

GREATEST of them all! That's the ARRL 1974 National Convention, sponsored by Hudson Amateur Radio Council. Remember the dates – July 19, 20, 21 at the Waldorf-Astoria, New York City. Three days of exciting events! Wide array of demonstrations, exhibits and forums featuring latest in FM, SSTV, ATV, RTTY, FAX, Satellites, Antenna design, Transistors, Integrated Circuits, DX, MARS, ARPSC and much more. Something to do every exciting minute for YLs & XYLs – Tours, New York sightseeing, visits to popular TV shows, Parties, Fashion Shows. Meet the ARRL President, Vice-presidents, and all 16 Directors! Famous-name Speakers at Saturday Night Banquet! Everything for the Non-Ham, New Ham and Old Timer. For info, Contact: ARRL Convention, 303 Tenafly Road, Englewood NJ 07631.

DANVILLE HAMFEST at Douglas Park in Danville IL on September 1, 1974. Take Bowman Avenue Exit off I-74 and follow the signs. Prizes will include a low-band rig and VHF gear, antennas, electronic keyer, wattmeters, SWR bridges, and many others. Camping and motel accomodations nearby. Food and plenty of parking available. Huge flea market and commercial displays. Tickets are $2 or three for $5. Advance tickets available from Dave WA9PDS, Dolan Rd., Catlin IL 61817. Send check or M.O. and SASE. Talk-in on 22/82 and 94 simplex.

BUY-SELL-TRADE write for monthly mailer, give name, address, call letters. Complete stock of major brands new and reconditioned equipment. Call us for best deals. We buy Collins, Drake, Swan, etc. SSB & FM. Associated Radio, 8012 Conser, Overland Park KS 66204. 913-381-5901.

EQUIPMENT FROM 73

The following list of gear, unless otherwise noted, consists of brand new equipment purchased for testing purposes only. Some have been tested, some remain unopened in original cartons. We are offering this gear at a considerable discount on a first-come-first-served basis. Please send Money Orders or Certified Checks only to 73 Magazine, Peterborough NH 03458.

NITS 8000M Calculator w/p.s./case ($143) new	$ 90
Heath IB-101 counter ($170) – 5 hp	$ 140
Vanguard Scaler – to 10 – to 200 MHz ($120)	$ 75
Regency 10ch scanner TIME-H-LMH ($300)—new—	$ 245
SBE Scanniver, complete, like new ($800)	$ 500
Pickering CW keyboard KB-1 ($265)– tested	$ 175
Gladding Hi-Stan – 8ch scanner – tested ($180)	$ 99
Gloucale KW 2m amplifier – used	$ 350
Heath IC-2009 calculator – brand new ($92)	$ 60
Standard 146B 2m 23ch xcvr 10w ($550) – used	$ 250
Signal One CX7-A – tested – perfect – like new – Deerfield	$1000
Kenwood Twins – Tested – like new ($600)	$ 750
Standard 146 2m HT – used ($295)	$ 190
Fanon intercom – exec – 6 ch master – ($60) tested	$ 35
Concord video monitor VM-12 – tested ($400)	$ 250
Concord all channel TV tuner Dom-911 ($300)	$ 200
Bell & Howell 2985 portable VTR – new ($1695)	$ 475
Batteries for B&H 2985 – like new ($36)	$ 25
Regency 400 MHz scanner – ($200) – like new	$ 140
Varitronics PA-50 2m amp ($110)—brand new—10w in 50 watt	$ 75
RF tone burst gen—5 freq—TO 5—mod($37.50)	$ 25
Hitachi stereo cassette recorder—exc—($120)	$ 75
Hitachi AM-FM cassette recorder—exc—($90)	$ 60
Antenna Spec rubber ducky antennas HM-4 2m	$ 4
SWR meter—exc ($25) KW	$ 12
Test Labs—10 in 1—SE-400 ($25) as is	$ 10
Radio Shack Code cassette—new($6)	$ 4
Regency MR-6 ($260) six meter 10w xcvr 12ch	$ 180
Standard SR-C826MA ($300) 2m 10w xcvr 12 ch	$ 200
Regency ACT-R8H/L 8ch ($160) VHF/UHF 8ch scanner	$ 125
Standard SR-C826MA ($300) Latest model 10w 12ch 2m xcvr	$ 230
Regency HR-2MS ($315) 2m 15w xcvr with 8ch scanner	$ 260
SBE 5A-454/FAC ($480) 454 MHz transverter	$ 140
SBE 5B-1PA ($190) 10w in 40w out power amplifier 2m	$ 150
Regency Pocket scanner 4 channel ACT-P4H ($120)	$ 90
Cobra 220 MHz Transceiver 10w 12ch ($300)	$ 225
Amphenol RG-8/U Polyfoam 100' w/PL-259 connectors($24)	$ 19
Standard 146 2m 23ch superheterodyne rig, VOX($310) demo	$ 230
Pacilicom 2m HT—brand new—($250)	$ 190

All Prices Fob: UPS collect.

73 Magazine – Peterborough NH 03458

462.60MHz FM 6/12V mobile tube tranceivers; 15 complete GE 4ES14A1 450-470MHz 20 watt units for sale, $50 each. Additional specs upon request. Tony Hogg, WHLM Radio, Bloomsburg PA 17815.

FREE BARGAIN CATALOG. Transistors, Relays, ICs, Puts, Leds, Readouts, Resistors, Capacitors, Thermocouples, Transducers, Circuit Boards, Unique Components. Chaney's Dept. A, Box 15431, Lakewood CO 80215.

THE 27th ANNUAL Turkey Run Hamfest and VHF Picnic, sponsored by the Wabash Valley ARA, Inc., will be held Sunday, July 28, at Turkey Run State Park near Rockville, Indiana. Don't miss the Midwest's finest fleamarket. Fun for the whole family: XYL Bingo and fleamarket; food and refreshments, camping facilities, and park recreation for the kids. First Prize: Genave GTX-10, Second Prize: Regency HRT-2, Third Prize: Drake WV-4 VHF Wattmeter; plus many more. Activities begin at 9:00 AM with free coffee and doughnuts. Talk-in 146.94 by W9UUU/9. For details, send SASE to WVARA Hamfest, Box 81, Terre Haute IN 47808.

GREATER Indianapolis Hamfest, Sunday, July 14, 1974, rain or shine, Marion County Fair Grounds, all activities under roof. $2.00 covers gate fee and prize drawing. For information write: Wm. J. Evans, 8104 Crest Hill Dr., Indianapolis IN 46256.

FREE Crystals with the purchase of any 2m FM radio. Write for our deal on the rig of your choice. Factory-authorized dealers for Regency, Drake, ICOM, Alpha, Tempo, Kenwood, Genave, Swan, Clegg, Ten-Tec, Standard, Midland, Telex, Hallicrafters, Venus, Hy-Gain, Galaxy, CushCraft, Mosley and Hustler. For the best deal around on VHF or HF gear, see us first or see us last, but see us before you buy. Write or call us today for our low quote and become one of the many happy and satisfied customers of Hoosier Electronics, R.R. 25, Box 403, Terre Haute IN 47802. 812-894-2397.

HAMFESTERS 40th Annual Hamfest and picnic, Sunday August 11, 1974, at Santa Fe Park, 91st and Wolf Road, Willow Springs IL (southwest of Chicago). Exhibits for OM's, XYL's. Famous Swappers Row. Information – contact, Vince Pronites WA9EOM, 7206 So. Damen Avenue, Chicago IL 60636. Tickets write – Jos. Paradyla WA9IWU, 5701 So. California Avenue, Chicago IL 60629.

THE ORIGINAL FM Hamfest Sunday August 4, 1974, near Angola IN. Free flea market, entertainment for ladies and kids. Picnic grounds, campsites, boating, food, soft drinks, available rain or shine. For information contact: Fort Wayne Repeater Assoc. Box 6022, Fort Wayne IN 46806.

ANTIQUE RADIO BUFFS. Do you need a schematic for your radio? For information send SASE showing make and model number. Joseph C. Crockett K3KUL, 762 S. Gulph Road, King of Prussia PA 19406.

TELETYPE EQUIPMENT For Sale: Models 14, 15, 19, 28, 32, 33. TD's, Reperfs, KSR's, ASR's. Parts or complete machines. Write needs and send SASE for complete listing and prices. Larry Pfleger, 10615 W. Ridge Rd., Apt. 54, Hales Corners WI 53130.

"73 MAGAZINES" in binders. First thru latest, make offer on complete set only. Wm. Coldewey Jr. WA8DJS, 5733 Linden Drive, Milford OH 45150.

UPPER PENINSULA Hamfest, August 3 & 4, 1974, Negaunee Township Hall, Negaunee MI. Hiawatha Amateur Radio Association host. Registration $2. Swap n' Shop, Program for XYL's, Door Prizes. Mobiles talk in on 3.920 and 146.94. Reservations & info: Frank K4CGQ/8, 322 Fortress, Sawyer AFB MI 49843. 906-346-5501.

FOR SALE 2 each EIMAC 4CX1000A with sockets and filament trtransformers, $200. Also RCA 7094 with sockets, $18 each. Write: Dave Kiech, 3615 Harrison St., Riverside CA 92504.

WARREN HAMFEST, largest family style hamfest in the East. Sunday, August 18th, at Famous Yankee Lake Park. Giant Fleamarket, Swimming, Picnicing: All free. Details, QSL W8VTD.

KIRLIAN photography kit: Complete, with instructions, $19.95 + $1.50 postage. BOOK: "The Kirlian Aura," $3.95 + $.75 postage. Systecon, Department 21, Box 417, West Hyattsville MD 20782.

WANTED TO BUY Scott Philharmonic XXX or McCurdo Silver Masterpiece VI. David Singer, 10301 Alpine Drive, Cupertino CA 95014.

BCD Adder-Subtractor Experiment. Complete instructions tell how to build, add, subtract, multiply and divide for $2.00. Sollee Enterprises-T, Box 41283, Los Angeles CA 90041.

FOUNDATION for Amateur Radio Annual Hamfest Sunday, October 20, 1974 at Gaithersburg Maryland Fairgrounds.

MIX PLEASURE with pleasure at the Hamburg International Hamfest on September 21. For information contact Lin Brownell WB2HCL, 210 Buffalo, Hamburg NY 14075.

TECH MANUALS for Government surplus gear – $6.50 each: R-390/URR, R-220/URR, URM-25D, CV-591A/URR, CV-278/GR, TRM-1, TS-382D/U, TS-497B/URR, TT-63A/FGC, URM-32. W3IHD, 7218 Roanne Drive, Washington DC 20021.

MOBILE IGNITION shielding gives more range, no noise. Everything from economical suppression kits to custom shielding. Literature estes engineering, 543-A West 184 Street, Gardena CA 90248.

SELL Drake 2C Receiver with matching noise blanker crystal calibrator speaker $150 postpaid, George Konnick, Apt. P2, 1750 West Main Street, Riverhead NY 11901.

VIDIO RECORDER Ampex VR6500 like new with vidio monitor and cables $475. Sam Wood 12648 La cresta Ct, Los Altos Hills CA 94022. Telephone 415-941-8000.

MOTOROLA PORTABLES – Expert repairs, reasonable prices, fast turnaround time. More details and flat rate catalog FREE. Ideal Services, 6663 Industrial Loop, Greendale WI 53129.

FOR SALE: – TV7B Tube Testers. Some need repairs. $16.95 shipped UPS collect. NJ residents include 5% sales tax. Capacitor materials Inc., P.O. Box 413, West Long Branch NJ 07764.

WANTED: HT200 2 meters, any condition. State price and condition. Ron Dierkens WA6QVE, 3367 Ellington Dr., Altadena CA 91001.

FOR SALE: All issues of 73 Magazine. All reasonable offers considered. Prefer local buyer. D.S. De Armond W6MSD, 100 Glen Eyrie #2, San Jose CA 95125.

SELL: Drake TR4, AC4, MS4 Speaker, Heath HD-10 Keyer, HM-102 Wattmeter, HD-15 Phone Patch, Eico Model 460 DC Wide Band Oscilloscope 2KW Linear Homebrew. All Mint, Best Offer. Knud E. M. Keller c/o 73 Magazine, Peterborough NH 03458.

VERY INTERESTING! Next 5 issues $1. "The Ham Trader," Sycamore IL 60178. (Ask about our "HAM EQUIPMENT BUYERS GUIDE" covering Receivers, transmitters, transceivers, amplifiers 1945–74. Indispensable!)

CRAMPED for antenna space? Slinky Dipole for 80/75, 40 & 20m operates efficiently at 24 feet long on 80m. Money-back guarantee. Complete kit $30.95 ppd., COD $1 extra. Teletron Corp., Box 84-S, Kings Park NY 11754.

MONTREAL HAMFEST 74, August 4, MacDonald College Farm, Ste Anne de Bellevue. Prizes, Giant fleamarket, technical sessions, family fun, $2.50/adult. Info contact: VE2RM, Box 201, Pointe Claire-Dorval, Quebec H9R 4N9.

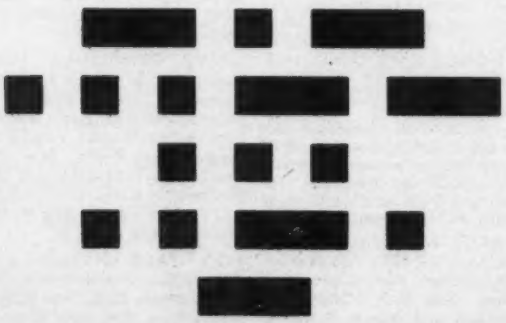
AUTOMATIC TELEPHONE Answering Computer. The best available. List $239.95. I have two new and still in boxes for $150.00 each. Warranty is still good. First check takes one or both. WB8CTA, 1000 Moore Road, Conway MI 49722.

NOW PAYING $1750.00 and up for 618T/ARC-102 – $1200.00 and up for ARC-51 – $1500.00 and up for GRC-106, also parts for these sets. D & R Electronics, R.D.#1, Box 56, Milton PA 17847 after 6:00 1-717-742-4604.

WYOMING RANCH LAND. No QRM-QRN. Wild horses, antalope, deer. 10 acres – $25 down, $25 month. Owner – Michael Gauthier K6ICS, 9418 Florence, Downey CA 90240.

HERE IT IS – Heathkit 10-105 – still in the box unassembled. List $400 – our sensational price $379.00. 73 Magazine, Peterborough NH 03458.

QSL CONTEST



"A stark representation and realization of the universal unimportance of everything. A deeper understanding of the unrealized self revealing all of the traumas and hidden meanings of the inner self." Those were just a few of the comments we received from a well known art critic when he was shown this card. When we told him that it was an amateur radio QSL card and not a work by one of the newer artists around he went away muttering to himself.

However, putting all of the above aside, we proudly announce this month's winner, William W. Ehlers K3SFT, of Sykesville MD. Congratulations.

Even if your card doesn't reveal a message of cosmic importance you have a chance to win a one year subscription to 73. Enter your card today. Send it to 73 Magazine, Peterborough NH 03458.

30 WATTS OUTPUT

2—meter FM amateur band mobile transceiver — 30 watts, 12 channels **MODEL 13–505**

(1) Midland 13-505 (built-in DC PS) . . **$299.95**

(2) DELUXE REGULATED 12 AMP AC SUPPLY **69.95**

(3) 5 crystals: Tx 34, 16, 94; Rx 94,76 . . . **N/C**

REGULAR . . . $369.90

OUR SPECIAL PACKAGE PRICE . . . $299.00

● 30 WATTS OUTPUT, ALL SOLID STATE (NO TUBES) ● MOTOROLA FINAL TRANSISTORS ● SUPERB PROFESSIONAL LEVEL QUALITY AND CONSTRUCTION ● TRIMMER CAPACITORS XMIT AND RCV XTALS ● SEPARATE CHANNEL SELECTORS GIVE SIMULTANEOUS OR SELECTIVE CONTROL OF TRANSMIT AND RECEIVE FREQUENCIES-144 CHANNEL COMBINATIONS ● DISCRI-METER SHOWS FREQUENCY SHIFT OF RECEIVED SIGNALS, ACTS AS CALIBRATION METER FOR RECEIVER AND TRANSMITTER ● S/RF/SWR METER SHOWS RECEIVED SIGNAL STRENGTH, RF POWER OUTPUT, SWITCHES TO SHOW ANTENNA SWR-D'ARSONVAL METERS ● HI/LO TRANSMITTER POWER: 5 WATTS OR 30 WATTS ● FULL SHORT OR OPEN SWR PROTECTION ● PRIORITY CHANNEL ● DYNAMIC MICROPHONE ● SUPERB UNEQUALED EMPHASIZED EFFECTIVE HI-FI AUDIO QUALITY ● MOBILE MOUNT ● ACCESSORY JACK FOR TONE PAD, ETC. ● EXTERNAL SPEAKER JACK ● TEST POSITION TO MONITOR OWN SIGNAL ● AND MUCH, MUCH, MORE. SIZE: 9½ X 8½ X 3. ALL CORDS, PLUGS, MOBILE BRACKET, MICROPHONE HANGER, ETC., INCLUDED.

CLEGG FM-27Bs

Reg. $479.95, or with Clegg AC. . . Reg. $559

WRITE FOR SPECIAL DEAL!

MIDLAND 13-520

NEW!! *4 way switch* — Provides 146T&R, 146 T—147R, 147T—146R

Reg. $229.95

- **SUPERB QUALITY**
- 2 watts, 6 channels *with* carrying case and 16/76, 34/94 & 94/94.
- Please write for special packages with NI-CAD pack, charger, etc.

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REGENCY, CLEGG, SBE, INOUE, CUSHCRAFT, DATA ENG., BIRD, OLIVER SWAN (KLM), HY-GAIN, B&K, KENWOOD, TEMPO, TEN TEC, DX ENG., MINI PRODUCTS, SWAN, MIDLAND, ETC., IN STOCK — PLEASE WRITE FOR QUOTE.

Regency **WRITE FOR SPECIAL DEAL**

HR-2MS — 8 Channel Transcan 2 Meter FM Transceiver

HR-212 — 12 Channel-20 Watt 2 Meter FM Transceiver

HR-2B

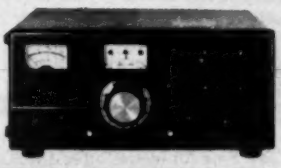
UNEQUALED AT ANY PRICE

HENRY 3K–A

Cool and Easy Max. Legal Power ● SSB, CW, RTTY or SSTV ratings ● 3.5 to 30 MHz ● Continuous duty ● Silver plated PI-L plate tank ● DC relays ● ALC ● built in SWR bridge ● Output power 2 KW min. in commercial service.

The Finest Commercial Grade Amateur Linear Amplifier Available Anywhere in the World at ANY Price for ONLY $1150 — The HENRY 3k–A.

You will never know how little it costs to own THE incomparable HENRY 3K—A until YOU write or phone us and let us know the trade in deal YOU WANT. We usually say yes! NO ONE ANYWHERE BEATS OUR DEAL.



KENWOOD TS-520

The new TS-520 is the transceiver you have wanted, but could not buy until now. It is a no-compromise, do everything, go everywhere 5 band transceiver for SSB or CW that performs equally well at home, in an automobile, airplane, boat or trailer. The TS-520 features built-in AC power supply, built-in 12 volt DC power supply, built-in VOX with adjustable gain delay and anti-VOX .. PLUS A HOST OF OTHER IMPORTANT FEATURES AND PROVEN Kenwood reliability. All at a price most amateurs can afford. The price . . . $629.00

KENWOOD TS-900

. . . the ultimate tranceiver. The promise of the transistor has been fulfilled. Here is the transceiver you will want to own . . . whatever you have now, get ready to trade up. Its important features are far too numerous to list. Its specifications are superb. The TS-900 is unquestionably the best transceiver of its kind ever offered. The price . . . $795.00

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25¢ 50¢ $1.00 SALE

$1.00 Telescoping Antennas $1.00

Part #	Sections	open	closed	dia.	Swivel	Hinge
A	11	56-1/2	6	7/16		
B	8*	32-1/8	6	5/16	X	X
C	10	47	6-1/2	11/32	X	X
D	11	26-3/8	3-3/4	3/8		
E	8*	26-3/4	5-1/4	5/16	X	X
F	7	29-3/4	5-1/2	9/32		
G	6	19	5	1/4		X
H	8	30-3/4	6	5/16		
I	9*	26	5	11/32	X	X
J	8	32-5/8	5-1/8	5/16		
K	8	32-1/2	6-7/8	9/16	X	X
L	8*	32-1/2	6-1/4	5/16	X	X
M	6	19	4-1/2	1/4		
N	7	24-1/4	4-1/2	1/4		
O	6	27-1/2	6	7/32		
P	Assortment 3/$2.00 No Choice					

*Bottom section used inside case for mount

*Brass base and top hat

SPEAKERS

8Ω	80mW	2" Round
11Ω	200mW	2¼" Round

50¢ each

8Ω	3W	5x7 Oval
8Ω	3W	4x6 Oval
8Ω	2W	4x4 Square
8Ω	2W	2½x7 Oval
8Ω	800mW	3½ Round

$1.00 each

Standard Size 15/16" body 5/16" thread 1/4" shaft 20K, 100K 25¢. 10K, 500K, 1meg—w/sw50¢. 5K/10K concentric w/sw 75¢. Miniature size 3/4" body 1/4" thread 1/4" shaft 50K 25¢. 5K s/sw 50¢. Miniature size 5/8" body 7/32" thread 3/16" shaft 2.5K 25¢. 5K, 10K w/sw 50¢. Ultra Miniature Transistor Radio Volume Controls s/switch 2K, 2.5K, 5K, 7.5K, 15K. Your choice 25¢ ea. – 5/$1.00.

ANOTHER TON OF GOODIES Over 50 types of audio driver & output transformers for transistor circuits. Micros, minis, "CB" radio size, etc. **$.25 each, 5/$1.00**

PLASTIC BATTERY HOLDERS Your choice 4'C' or 4 'AA' or 4 'A' w/leads. **$.25 each, 5/$1.00**

WE GOT A TON OF 'EM Transistor radio tuning caps for AM, AM–FM. Micros, minis, sealed, open. Over 40 types. **$.25 each, 5/$1.00**

TRANSISTOR RADIO EARPHONES – your choice mini or micro plug, long cord – **$.25 each, 5/$1.00.**

4 PDT RELAY Miniature pcb enclosed in clear plastic. Gold contacts **$2.00**

VIDEO TAPE BONANZA New American made ½" cobalt energized video tape 2400' on 7" reel in nice box. **$21 each, 5 & up – $15 each.**

RUBBER TAPE RECORDER Drive Belt assortment **$1.00**

6 FEET LONG! cord, not shielded with female connector on one end **only $.25**

CAR LIGHTER PLUG w/5 foot cord! **$.50**

RADIO & INSTRUMENT KNOBS over 100 types.**$.05 each.**

TRANSISTOR TAPE RECORDER ½ track mono head assembly for ¼" tape. Consists of erase, R/P heads, pressure pads mounted on base plate as used in MAYFAIR 1802. A steal at **$1.00 each.**

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LV BRIDGE & ½ BRIDGE RECT. Fine for meters other LV 500 mA. Your choice **$.25**

MINI & MICRO JAX for mic or earphone your choice. 2 circuits w/nc sw.**$.25, 5/$1.00**

4P 3 POS ROTARY SW 5/16" thread ¼" diameter shaft. **$.25**

JUNK BOX SURPRISE All good parts. Quantities too small to advertise. **$2.50**

ASSORTED TRANSISTOR RADIO 455 kc & 10.7 i-f transformers & osc. coils. Over 100 types. Micros, minis, etc. **4/$1.00.** *Specify 1st, 2nd, 3rd i-f or osc. & size, 455 or 10.7.*

GET A GRIP ! Handles – use for mobile mounts. Chrome, 4" x 11", large hole in end **$.25**

SUPER SMALL TRIMMER CAPS rotational, singles – $.20, duals – $.25, quads – $.50. Terrific for xtal netting. Multis have common "GND"

ASSORTMENT of 110V AC phono, tape, fan motors. Also some DC phono and tape motors **$1.00**

ASSORTED FERRITE ANTENNAS & RODS. Over 50 types. **4/$1.00, 1 of each $10.00**

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40/20/20	50WVDC	Upright Tab MT
40/20/5	150/150/25	1-7/8L x 7/8Dia.
1200/1200	15V	Can 50¢ ea.
1000/1000	20V	Can 50¢ ea.
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500	15V	Tubular 25¢ ea.
500	50V	Tubular 25¢ ea.
500	10V	Tubular 25¢ ea.
470	10V	Tubular 25¢ ea.

Assortment other values 4/$1.00

Over ½ million parts on hand! The boss says get rid of 'em. 50% off if you'll buy all we have of an item! **Top that $1 a pack people.**

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MH8913J $18.00

DATA and APPLICATION SHEETS FURNISHED WITH ORDER

general specifications

Frequency Drift[1]: < 1.5%

Group Amplitude Stability: ±25%

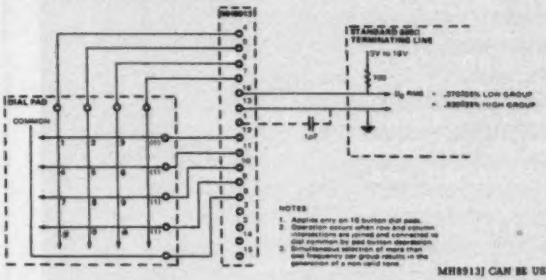
Total Distortion (Harmonic + Intermodulation): < 5% (relative to level of fundamental frequencies)

Typical Rise Time to Specified Output and Frequency:
1) Frequency selected, power supply switched < 5ms
2) Power applied, frequency selector switched < 2ms
3) Power applied, frequency within same group changed < 2μs

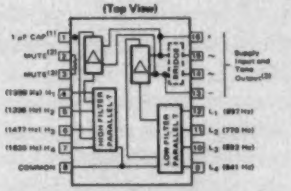
features

- Dual Frequency Capability
- Standard Telephone Tone-Dial Frequencies: Low Group – 697, 770, 852, 941 Hz; High Group – 1209, 1336, 1477, 1633 Hz
- Specification Ratings Exceed CCITT Recommendations

typical circuit connection diagram



block diagram and pin configuration



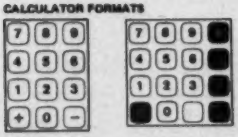
MH8913J CAN BE USED WITH CHOMERICS #ER21624 TOUCH TONE KEYBOARD

CHOMERICS

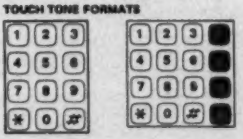
QUICKEY® TACTILE KEYBOARDS

FORMATS
Standard legends are black and white set in Standard Medium type.

CALCULATOR FORMATS

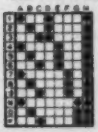


TOUCH TONE FORMATS

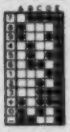


CODING

Touch Tone 12 Key

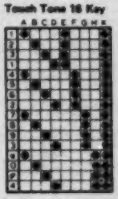


BCD 12 Key

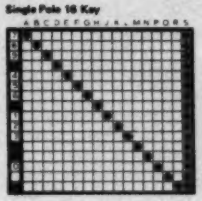


Single Pole 12 Key

Touch Tone 16 Key



Single Pole 16 Key



1/2" centers Model #	Price	3/4" centers Model #	Price	Format	Coding	# of Keys
ER 21622	7.15	ER 21605	7.70	Touch tone	Single pole	12
ER 21623	8.70	ER 21606	9.25	Touch tone	Touch tone	12
ER 21624	9.25	-	-	Touch tone	Direct to MH8913	12
-	-	ER 21607	7.70	Calculator	Single pole	12
-	-	ER 21608	11.00	Calculator	BCD	12
ER 21625	8.70	ER 21609	9.25	Calculator	Single pole	16
-	-	ER 21610	9.25	Touch tone	Single pole	16
-	-	ER 21611	11.15	Touch tone	Touch tone	16

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The Hy-Gain 270 is specifically designed to solve the problems common to 2 meter gain antennas... hard tuning, high VSWR, poor pattern due to irregular ground plane, and "picket fencing" from whip flex. The 270 develops outstanding gain through use of two stacked 5/8 wave radiators and operates completely independent of car body grounding by utilizing a self-contained, 1/4 wave decoupling system. There is no irregular ground plane, so there's minimum pattern distortion and fading due to whip flex. This all-fiberglass design can be used anywhere: fixed, land-mobile or marine, with the 271 mount.

- 250 watt rated.
- 6.0 db gain.
- 144-148 MHz.
- VSWR less than 1.5:1 at resonance.
- 96" whip height.
- No pruning required, completely factory tuned!
- 50 ohm input.
- 3/8 x 24 standard mobile thread.
- Comes with 18' coax and PL-259 connector.

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Mounts – Universal No. 271
Flush Body No. 499
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Get maximum range...get a Hy-Gain 270!

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Hy-Gain Electronics Corporation, 8601 Northeast Highway Six, Lincoln, NE 68507; 402/464-9151; Telex 48-6424
Branch Office and Warehouse, 6100 Sepulveda Blvd., #322, Van Nuys, CA 91401; 213/785-4532; Telex 65-1359
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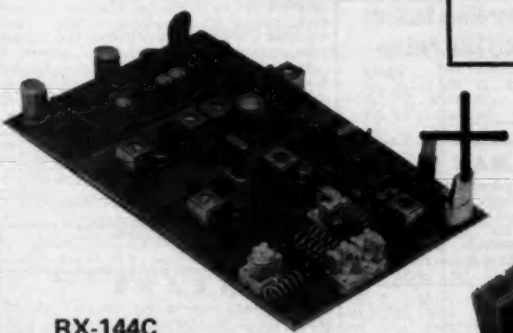
2 METER F.M.
portable

4 CHANNELS 2 WATTS
DUAL CONVERSION

HT-144

ONLY **$99.95** *KIT*



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KIT

TX-144
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7-SEGMENT READOUT

12-PIN DIP

- Three digits with right-hand decimal
- Plugs into DIP sockets
- Similar to (LITRONIX) DL337
- Magnified digit approximately .1"
- Cathode for each digit
- Segments are parallel for multiple operation
- 5 - 10 MA per segment

BRAND NEW

EACH $3.00 4 (12 Digits) $11.00

RCA NUMITRON

EACH.....$ 5.00

SPECIAL: 5 FOR $20.00

DR2010

Potter & Brumfield

TYPE KHP RELAY 4 PDT 3A CONTACTS

24 VDC (650 coil)....$1.50

120 VAC (10.5 MA coil).... 1.75

Power Supply SPECIAL!

723 DIP variable regulator chip 1-40V, + or - output @ 150 MA 10A with external pass transistor--With diagrams for many applications.

EACH....$1.00 10 FOR....$8.95

CT5005 CALCULATOR

This calculator chip has a full four-function memory, which is controlled by four keys, +M (adds entry into memory), -M (subtracts entry from memory), CM (clear memory, without clearing rest of registers), RM (read memory or use as entry).

- 12-Digit display and calculate
- Fixed decimal at 0, 1, 2, 3, 4, or 5
- Leading zero suppression
- 7-Segment multiplexed output
- True credit sign display
- Single 28-pin chip

CHIP AND DATA.....ONLY $14.95

DATA ONLY (Refundable)..... 1.00

5001 CALCULATOR

40-Pin calculator chip will add, subtract, multiply, and divide. 12-Digit display and calculate. Chain calculations. True credit balance sign output. Automatic over-flow indication. Fixed decimal point at 1, 2, 3, or 4. Leading zero suppression. Complete data supplied with chip.

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5002 LOW POWER CHIP AND DATA..12.95

All ICs are new and fully-tested; leads are plated with gold or solder. Orders for $5 or more will be shipped prepaid. Add 35¢ for handling and postage for smaller orders; residents of California add sales tax. IC orders are shipped within 2 workdays--kits are shipped within 10 days of receipt of order. $10.00 minimum on C.O.D.s (phone in).

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This logic family is unique in that both NPN and PNP transistors are combined in the same package. Unlike TTL and DTL, the outputs are current sources (in the high state) as well as sinking current in the low state. Those are brand new units, some of which are mismarked with DTL numbers.

CTL 9956 dual 2-input AND buffer

CTL 9953 2-2-3input AND/OR gate

CTL 9952 dual 2-input NOR gate

Data supplied; all parts are dual-in-line.

MIX OR MATCH 5 FOR $1.00

LED's

MV50 red emitting 10-4 ma @ 2V $ .20 10 FOR 1.25

MV5024 red TO-18 high dome $ .35 10 FOR 2.95

MV10B visible red 5-7 ma @ 2V $ .30 10 FOR 2.50

CMOS

CD4001	$ .75	74C20	.75
CD4002	.75	74C160	3.25

3-Amp Power Silicon Rectifiers Marked Epoxy Axial Package

PRV	PRICE	PRV	PRICE
100.....	$ .10	800.....	$ .30
200.....	.15	1000....	.40
400.....	.18	1200....	.50
600.....	.23	1500....	.65

MAN 1

7-Segment, 0-9 plus letters. Snaps in 14-pin DIP socket or Molex. Operates with IC voltage requirements. Long operating life.

ONLY $3.25

7400	$ .25	74L51	$ .30
74H00	.35	74H51	.35
7401	.20	7453	.20
74H01	.35	7454	.25
7402	.35	74L54	.35
7403	.30	74L55	.35
7404	.28	7460	.20
74H04	.35	74L71	.30
7405	.28	7472	.40
7406	.70	74L72	.50
7408	.35	7473	.60
74H08	.35	74L73	.75
7410	.25	7474	.65
74H11	.35	74H74	.80
7413	1.25	7475	1.40
7417	.40	7476	.60
7420	.25	74L78	.80
74L20	.35	7480	.65
74H20	.35	7483	1.00
74H22	.35	7489	4.00
7430	.25	7490	1.20
74H30	.35	7492	.90
74L30	.40	7493	1.15
7440	.25	7495	1.15
74H40	.35	74L95	2.00
7441	1.25	74107	.70
7442	1.20	74121	1.25
7445	1.75	74154	2.30
7447	1.50	74193	1.50
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74H50	.35		
7451	.25		

7400 Series DIP

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V5447	2A	400V	$ .90
V5647	2A	600V	1.10
MR810 Rect.		50V 1A	.10

Special 811: Hex Inverter

TTL DIP Hex Inverter; pin interchangeable with SN 7404. Parts are brand new and are branded Signetics and marked "811."

Data Sheet Supplied

EACH.....$ .30

10 FOR..... 2.50

100 FOR.... 23.00

1000 FOR... 220.00

MAN 3

0-9 plus letters. Right-hand decimal point. Flat-pack type case. Long operating life. IC voltage requirements. Ideal for pocket calculators!

EACH $1.25

10 OR MORE 1.00

MAN4

Seven-segment, 0-9 plus letters. Right-hand decimal point. Snaps in 14-pin DIP socket or Molex. IC voltage requirements. Ideal for desk or pocket calculators!

EACH.....$2.75

TEN OR MORE 2.50 EACH

CD-2 Counter Kit

This kit provides a highly sophisticated display section module for clocks, counters, or other numerical display needs. The unit is .8" wide and 4 3/8" long. A single 5-volt power source powers both the ICs and the display tube. It can attain typical count rates of up to 30 MHz and also has a lamp test, causing all 7 segments to light. Kit includes a 2-sided (with plated thru holes) fiberglass printed circuit board, a 7490, a 7475, a 7447, a DR 2010 RCA Numitron display tube, complete instructions, and enough Molex pins for the ICs . . NOTE: boards can be supplied in a single panel of up to 10 digits (with all interconnects); therefore, when ordering, please specify whether you want them in single panels or in one multiple digit board. Not specifying will result in shipping delay.

COMPLETE KIT, ONLY $11.95

FULLY-ASSEMBLED UNIT $15.00

Boards supplied separately @ $2.50 per digit.

LINEARS

NE540	70-Watt power driver amp	$2.00
NE555	Precision timer	1.50
NE560	Phase lock loop DIP	3.25
NE561	Phase lock loop DIP	3.25
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NE567	Tone decoder MINI DIP	4.00
NE567	Tone decoder TO-5	3.00
NE5558	Dual 741 op amp MINI DIP	1.00
709	Popular Op Amp DIP	.45
710	Voltage comparator DIP	.75
711	Dual comparator DIP	.40
723	Precision voltage regulator DIP.	1.00
739	Low noise op amp DIP unmarked	1.00
741	Op amp TO-5/MINI DIP	.55
747	Dual 741 op amp DIP	1.00
748	Op Amp TO-5	1.00
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CA3026	Dual differential amp	1.00
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LM309H	5V 200 MA power supply TO-5	1.00
LM309K	5V 1A power supply module TO-3	2.00
LM311	Comparator TO-5	1.75
LM370	AGC amplifier	2.00
LM380	2-Watt Audio Amp	1.75
LM1595	4-Quadrant multiplier	2.00
MC1536T	Op Amp	2.00

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For This Issue Only
RADIO RECEIVER R–392/URR

Freq. Range: 500 KC to 32 MC in 32 bands. Types of Signals Received: CW, MCW, Voice (AM) and Freq. Shift Radio Teletypewriter. Type of Tuning: Continuous: Freq. Read Directly on Counter–Type Freq. Indicator. Method of Calibration: Built-in crystal Calibrator. Calibration Points: Every 100 KC. Nominal Input Voltage: 28 Volts DC; will operate on an input of 25 to 30 V, will operate at reduced gain.
PRICE: $195.00 **F.O.B. Philadelphia, PA**
Shipping Wt. 50 lbs. *(with schematic)*

FOR THIS ISSUE ONLY
We will include with every purchase the following accessories for the above receiver – **FREE**

1 Whip Antenna	$4.95
1 Speaker	$4.95
1 Mike	$2.95
1 Set Connecting Cables	$2.50
1 Head Set	$4.95
1 Telegraph Key	$1.95

ADJUSTABLE PRINTED CARD BOX
For Rack Mount
5" to 7¼" – 16 slides and sockets – includes 30 double contact position edge connector type
PRICE $9.95

MODERN ALUMINUM BENCH RACK CABINET
11½" H x 18" D x 19" W. 8" panel openings w/rubber feet and disappearing handle.
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Triad transformers F-21A 115 Volts 60 cycles 6.3 VCT at 10 Amps.
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R-508 VHF RECEIVER
118-148 MHz, part of ARC-60 aircraft radio set. Front panel tuning 118-148 MHz, lightweight, compact, 5" x 6" x 12". 28 VDC input, 250V, 50mA, dynamotor.
Price: $14.95

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Turns counting digital dial model 201 3 digit direct reading w/10 turn 5k/5% pot.
Price: $2.50 each, 5/$10.00

DIGITAL READOUTS SETS
Make your own counter, frequency meter, digital voltmeter, readouts, etc. Includes 6-B 5031 mixes w/sockets (6" character height), 1 transformer, 1 p/s board with socket.
Price: $12.95, 2/$20.00

Small B-5031 nixies no board w/socket **4/$5.00**

ANOTHER SPECIAL
LARGE ALPHA NUMERIC READOUTS
Two B7971 tubes in sockets, driver transistors and components all on one board – can be used for clocks, counters, numerous other uses. . . .
Price: $2.00 a board, 3/$5.00

SOCKETS
Sockets for 4 x 150's – 2 sockets with chimney, mounted on aluminum chassis
Price: $7.00

Lighted switches 2 pdt push pole panel mount 5/8" hold.
Price: $1.00 each, 6/$5.00

MODULE TYPE P/S
AC input 95-125 VAC-60Hz-100 watts.

+12VDC[a]	.375A
-12VDC[a]	.3A
- 6VDC[a]	.375A

Regulation 1%. Front panel adj. ±10%. 5 1/8" x 7 3/8" x 7"
Price: $14.95, 2/$25.00

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REPEATER LINE

All you need to know about 2 meter mobile antennas!

263 Special no-hole trunk lip mount. 3 db gain. 130-174 MHz. 5/8 wave. 16' coax. DC ground. Base matching coil for 52 ohm match. 17-7 ph stainless steel whip.

264 High efficiency, vertically polarized omnidirectional roof top whip. 3 db gain. Base matching coil for perfect 52 ohm match. DC ground. Coax and connector furnished.

265 Special magnetic mount. 3 db gain. Performance equal to permanent mounts. 12' coax and connector. Base matching coil for 52 ohm match. 17-7 ph stainless steel whip. DC ground.

Rugged, continuously loaded, flexible VHF portable antennas. Completely insulated with vinyl coating. Bend at all angles without cracking or breaking. Cannot be accidentally shorted out.

723N With UHF connector.

269 With 5/16-32 base for Motorola HT; Johnson; RCA Personalfone; Federal Sign & Signal; and certain KAAR, Aerotron, Comco and Repco units.

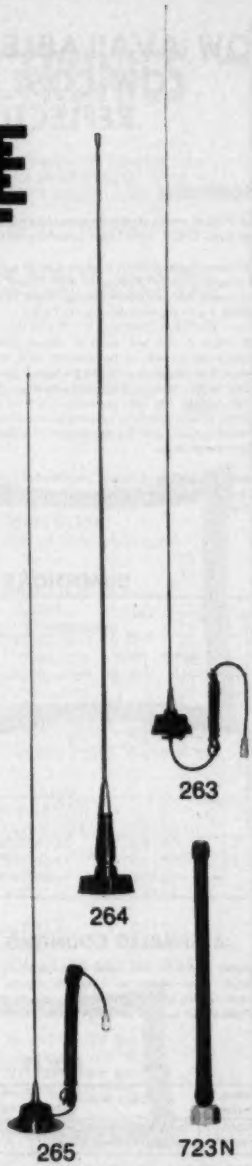
723A With BNC connector.

260 Commercial duty, 1/4 wave, claw mount, roof top whip. Precision tunable to any discrete frequency 108-470 MHz.

261 Same as above, with 18' coax and connector.

262 Magnetic mount whip, 108-470 MHz. 52 ohm match. Complete with coax and connector.

Write for details



hy-gain **ELECTRONICS CORPORATION**
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402/464-9151 Telex 48-6424
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NOW AVAILABLE FROM SOLID STATE SYSTEMS, INC.
LOW-COST FIELD EFFECT TRANSMISSIVE AND/OR REFLECTIVE LIQUID CRYSTAL AC DISPLAY

DESCRIPTION

Only one liquid crystal display provides excellent contrast and readability in diffused light: FELIX. Field Effect Liquid Crystal from Hixco.

FELIX liquid crystal displays produce superior optical properties than other liquid crystal systems because of their bi-level characteristic. The Felix display system has two distinct optical states, so that display segments are fully off at 3 volts and completely on at 7 volts.

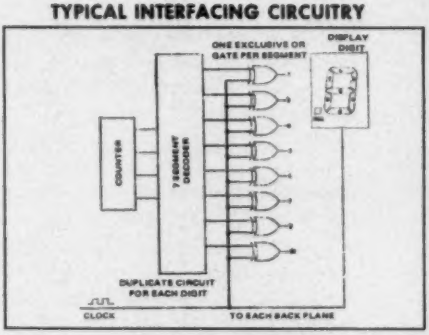
Bi-level refers to the two levels of optical activity present in specially organized liquid crystals. In the quiescent state, the level is referred to as a 90° rotation of the plane of polarized light. That is, when a liquid crystal organized in this manner is inserted between a polarizer and an analyzer which are parallel, the light transmission will be at a minimum. The other level of the bi-level system is zero degrees rotation of the plane of polarized light, which occurs upon the application of a well defined voltage, giving maximum transmission.

Extremely low voltage threshold provides full compatibility with TTL and MOS devices. The power consumption of the ON segment is less than ½ microwatt.

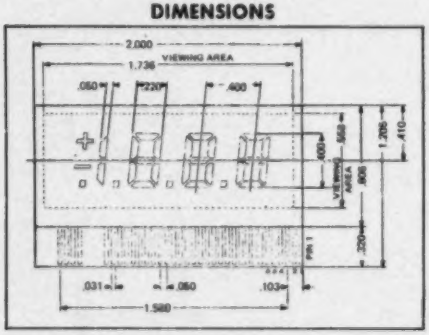
FEATURES

- ★ **Excellent contrast in ambient light**
- ★ **Field effect**
- ★ **Wide temperature range**
- ★ **Low voltage operation (7 volts)**
- ★ **Extremely low power consumption**
- ★ **Transmitted or reflected light displays**
- ★ **Operates 60–10 KHz**
- ★ **Plugable**

TYPICAL INTERFACING CIRCUITRY



DIMENSIONS



ASSEMBLED COUNTING BOARDS

Completely assembled and tested counting board, consisting of above display and connector, three decade to 7-segment decoder (7448), seven AC pulse drive generators (7486), and tin plated glass-epoxy PC board with edge connector pattern is available as part number 94-06051.

PRICES

Catalog Number	Description	1-4	5-9	10-24	25 Up
94-06051	Complete Assembly	15.50	14.50	13.50	12.50
94-06061	Display & Connector Only	9.75	9.00	8.25	7.50

PIN CONNECTIONS

PIN	SEGMENT	PIN	SEGMENT
1.	—	21.	b
2.	—	22.	g
3.	b	23.	c
4.	g	24.	d
5.	c	25.	B.P.
6.	d	26.	e
7.	B.P.	27.	f
8.	e	28.	a
9.	f	29.	DEC.
10.	a	30.	1
11.	DEC.	31.	DEC.
12.	b	32.	-
13.	g	33.	+
14.	c	34.	B.P.
15.	d	35.	—
16.	B.P.	36.	—
17.	e	37.	—
18.	f	38.	—
19.	a	39.	—
20.	DEC.	40.	—

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MAN3 4 for $2.00
MAN4 4 for $4.00

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PS 25-1 Zero to 25 volt 1 amp power supply with adjustable current limiting; has remote sensing & remote programming for voltage and current. Instructions included. All parts supplied except chassis & meter(s).

Kit of parts with schematic $14.95

LT-1 Digital logic tester, uses 5 volts, will test TTL, DTL and CMOS. Has internal slow clock. All parts supplied except power supply, chassis, panel & board.

Kit of parts with schematic $19.95

PS 5-1 5 volt 1 amp regulated power supply kit with p.c. board and instructions. Board measures 2" x 5"; completed kit is 2" high. Transformer has internal r.f. shield. $8.00

TTL

7400	$ .25	7475	1.00
7401	.25	7476	.65
7402	.25	7483	1.25
7403	.25	7485	1.40
7404	.30	7486	.50
7405	.30	7489	3.25
7406	.50	7490	1.00
7407	.50	7492	1.00
7408	.30	7493	1.00
7409	.30	7495	1.00
7410	.25	7496	1.00
7411	.30	74107	.60
7413	.90	74121	.60
7416	.50	74122	.60
7417	.50	74123	1.10
7420	.25	74125	.65
7430	.25	74126	.65
7432	.30	74141	1.25
7437	.50	74151	1.10
7438	.50	74153	1.40
7440	.25	74154	1.70
7442	1.10	74157	1.40
7446	1.45	74164	2.00
7447	1.45	74165	2.00
7448	1.45	74166	2.00
7450	.25	74176	1.60
7451	.25	74177	1.60
7453	.25	74181	4.50
7454	.25	74192	1.75
7473	.50	74193	1.50
7474	.50	74195	1.15
	74200 9.00		

OP AMPS

301T	$ .50
301M	.45
307T	.70
307M	.65
318T	1.50
709D	.20
709T	.30
709M	.25
739D	1.00
741D	.35
741T	.50
741M	.45
748M	.40
747/5558T	1.05
5558M	1.00
4131M	1.00
4132M	1.25

TRANSISTORS

NPN TO-18 general purpose silicon	.15
10 or more,	.10
PNP TO-18 general purpose silicon	.15
10 or more,	.10
2N2222 (NPN) TO-18	.25
10 or more,	.20
2N2907 (PNP) TO-18	.25
10 or more,	.20

LEGEND
T = TO-5
D = DIP
M = miniDIP

JUNCTION FETs, TO-18 case

N-CHANNEL:	SIMILAR TO:	
NJF10	2N4416, MPF102	3/$1.00
NJF11	2N4091-93	4/$1.00
NJF12	2N4338-41	4/$1.00
NJF13	2N3089	3/$1.00
NJF14	2N4221-22	4/$1.00
P-CHANNEL:		
PJF11	2N3382-86	4/$1.00
PJF14	2N2608	4/$1.00

All FETs come with data sheets.

WIRE WRAP SOCKETS

14 pin	$ .50
16 pin	.60
24 pin	1.25
28 pin	1.35
40 pin	1.80
wire-wrap socket pins	.05

$4/100

¼ WATT RESISTORS $ .05
$4/100

We have most 10% values.

1N914 EQUIVALENT DIODES
$ .10 $8/1.00

LEDS
LED 10R – Pack of 10 discrete red lens LEDs, various MV5020-series types. $1.50
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Application note included.

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RT-70/GRC **$20 each, 3/$50**

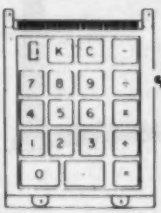
Latest government release. Transmitter-Receiver RT-70/GRC covers 47 to 58.4 mc FM. Requires only 90 Volts dc and 6 volts dc. Used, visually OK, supplied with schematic.
1 MC crystal used for calibration $4.00
116 page maintenance manual for GRC $2.00

TRANSFORMERS

BRAND NEW, 115 volt AC input. OP - AMP XFMR, out puts: 16 VCT ½ amp, 17 VCT ¼ amp. $3.50

FILAMENT or BTRY CHARGER XFMR

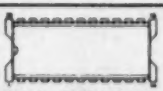
output of 18 volts at 4.5 amp $3.50



CALCULATOR KEYBOARD

~~$5.00~~ $3.00

Brand new keyboards for hand held calculators. Two styles available.
One for use with calculator chip CAL TEX 5001-5002-5012 or MOSTEK 5010-5012.
Another for use with Gen. Inst. chip C500.
Priced at ~~$3.00~~ each or two for ~~$5.00~~ $5.00.



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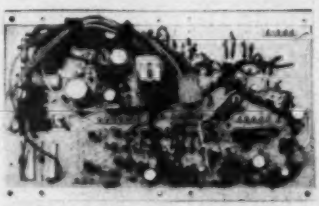

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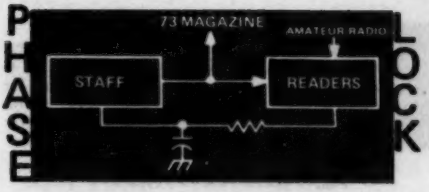

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28	29	30	31			

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AUSTRALIA	14	14	14B	7B	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	7A	7	7	7	7	14	14	14	14	14
ENGLAND	7A	7	7	7	7	7	7A	14	14	14	14	14
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INDIA	7	7	7B	7B	7B	7B	7	7	7A	14	14	14
JAPAN	14	14	7	7	7	7	7	7	7	7	7	14
MEXICO	14	14	7	7	7	7	7	7	7	14	14	14
PHILIPPINES	14	14	7B	7B	7B	7B	7B	7	7	7	7A	7A
PUERTO RICO	14	7	7	7	7	7	7	7	14	14	14	14
SOUTH AFRICA	7B	7	7	7	7B	14	14	14	14	14	7B	7B
U. S. S. R.	7	7	7	7	7	7	14	14	14	14	14	14
WEST COAST	14	14	14	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

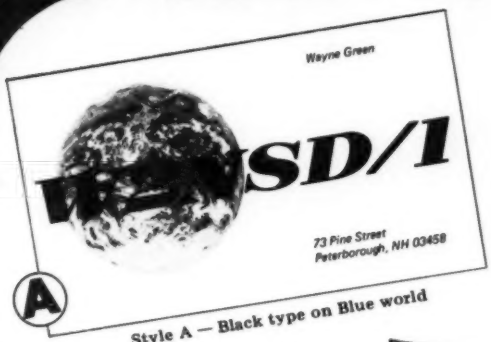
ALASKA	14	14	14	7	7	7	7	7	7	7	7	14
ARGENTINA	14	14	14	7A	7	7	7	14	14	14	14	14
AUSTRALIA	14	14	14	14	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	14	7	7	7	7	14	14	14	14	14
ENGLAND	7	7	7	7	7	7	7	7	7	14	14	14
HAWAII	14	14	14	7	7	7	7	7	7A	14	14	14
INDIA	14	7	7B	7B	7B	7B	7	7	7	7	7A	7A
JAPAN	14	14	14	7	7	7	7	7	7	7	7	14
MEXICO	14	7	7	7	7	7A	7	7	7	7	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7B	7	7	7	7A	7A
PUERTO RICO	14	14	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7B	7	7	7	7B	7B	14	14	14	14	7B	7B
U. S. S. R.	7	7	7	7	7	7	7	7	7	7A	14	14

WESTERN UNITED STATES TO:

ALASKA	7A	7A	7A	7	7	7	7	7	7	7	7	7A
ARGENTINA	14	14	14	7A	7	7	7	14	14	14	14	14
AUSTRALIA	14	14A	14	14	7A	7	7	7	7	7	14	14
CANAL ZONE	14	14	14	7	7	7	7	14	14	14	14	14
ENGLAND	7A	7	7	7	7	7	7	7	7	7A	7A	14
HAWAII	14	14	14A	14	14	7	7	7	7	14	14	14
INDIA	14	14	14	7B	7B	7B	7	7	7	7	7	7A
JAPAN	14	14	14	14	7	7	7	7	7	7	14	14
MEXICO	14	14	14	7	7	7	7	7	14	14	14	14
PHILIPPINES	14	14	14	14	7	7	7	7	7	14	14	14
PUERTO RICO	14	14	7A	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7B	7B	7	7	7B	7B	7B	7B	14	14	7B	7B
U. S. S. R.	7	7	7	7	7	7	7	7	7	7A	7A	7
EAST COAST	14	14	14	7	7	7	7	14	14	14	14	14

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

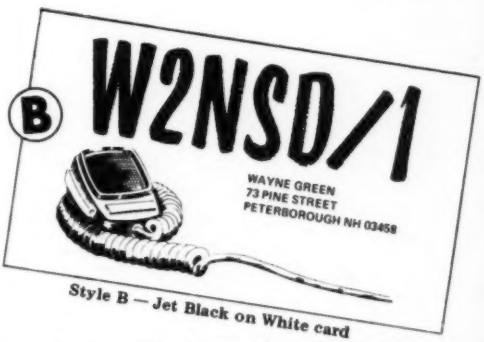
QSLs for 1¢



Style A — Black type on Blue world

- two styles
- QSO info back
- two colors
- LOW PRICES

While the cost of almost everything keeps spiraling upward, 73 has kept the price of these beautiful QSLs at rock-bottom. When we started selling *Top Quality* QSLs last year for a **PENNY-A-PIECE** (postpaid yet!) it was a fantastic deal; this year it's the next best thing to having an oil well in your own backyard!



Style B — Jet Black on White card

ORDER — AND PAY
250 . . . . . $6 (2.5¢ ea)
500 . . . . . $10 (2¢ ea)
1000 . . . $15 (1.5¢ ea)
2000 . . . . . $20 (1¢ ea)

These QSLs are printed on *Fine Quality Glossy Card Stock* and are as good or better than cards sold elsewhere for several times the price. We can offer this fantastic low price, because we "gang print" orders between other jobs in our own print shop which keeps the costs way down and we pass the savings on to you. If you haven't been QSLing as much as you'd like to because of the cost of cards, do you really have an excuse anymore? Get some cards and help improve the image of U.S. Amateurs.

☐☐☐☐☐☐☐☐☐☐☐☐☐☐ *ORDER BLANK* ☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Name _____ Call _____
(First and last name is most friendly)

Style
A ☐
B ☐

Address _____
(as brief as possible and still get through the mail)

City _____ State _____ ZIP _____ County _____
(a must) (if desired on the card)

Awards to be listed on card _____
(if desired)

☐ 250 ☐ 500 ☐ 1000 ☐ 2000 cards

Foreign Orders: Add following amounts for shipping and handling. (Parcel Post)

250 — $1.75 1000 — $4.00
500 — $2.25 2000 — $6.25

Amount enclosed $_____

Check local Post Office for air rates . .

A product of 73 Magazine, Peterborough NH

ADVANCED
AMATEUR
TECHNOLOGY from

YAESU

YOUR ASSURANCE OF PERFORMANCE
AND QUALITY

JOIN THE ACTION ON 2M FM

THE WORLD'S LEADER IN AMATEUR COMMUNICATIONS
NOW OFFERS YOU "TOTAL SPECTRUM COVERAGE"
FROM 160 THROUGH 2 METERS

SIGMASIZER 200R

200 CHANNEL
SYNTHESIZED 2M FM TRANSCEIVER

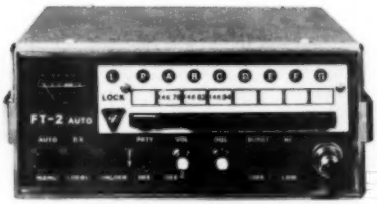
*NO CRYSTALS TO BUY. GET TOTAL REPEATER AND SIMPLEX OPERATION OVER THE ENTIRE FM BAND

***FEATURES**

- ☐ Complete 146-148 MHz coverage
- ☐ 200 channels in 10 KHz increments
- ☐ Selectable ±600 KHz repeater offset
- ☐ Built-in repeater tone burst
- ☐ Selectable repeater or simplex operation
- ☐ Priority channel provision
- ☐ Automatic final protection
- ☐ Plus many more exciting features

Amateur Net $449

Available soon from your dealer



FT-2 AUTO

AUTO-SCAN WITH PRIORITY CHANNEL
2M FM TRANSCEIVER

*AUTOMATIC SCANNING ALLOWS YOU TO CONTINUOUSLY MONITOR ALL OF YOUR FAVORITE CHANNELS

***FEATURES**

- ☐ Automatic scan of all 8 channels
- ☐ Hi/Low power: 10 Watts or 1 Watt
- ☐ Selectable scan of priority channel
- ☐ Individual channel lockout
- ☐ Automatic channel lock with mike
- ☐ Built-in AC & DC power supplies
- ☐ Built-in repeater tone burst
- ☐ Complete with three channels, cables, and microphone

Amateur Net $379

COMING SOON!

NEW FT-224 23 CHANNEL 2M FM TRANSCEIVER
WITH PRIORITY CHANNEL FEATURE

Watch for price announcement and further information on this new, low cost FM Radio

Prices and specifications subject to change without notice
Full dealer warranty with factory service available for continued after warranty service backup
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